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A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

Mining Methods at Gold Hill, Nevada

A description of United Comstock's underground operations

By George J. Young

Marketing of Gold

By Felix Edgar Wormser

Laboratory Tests for Chloride Blast Roasting and Leaching

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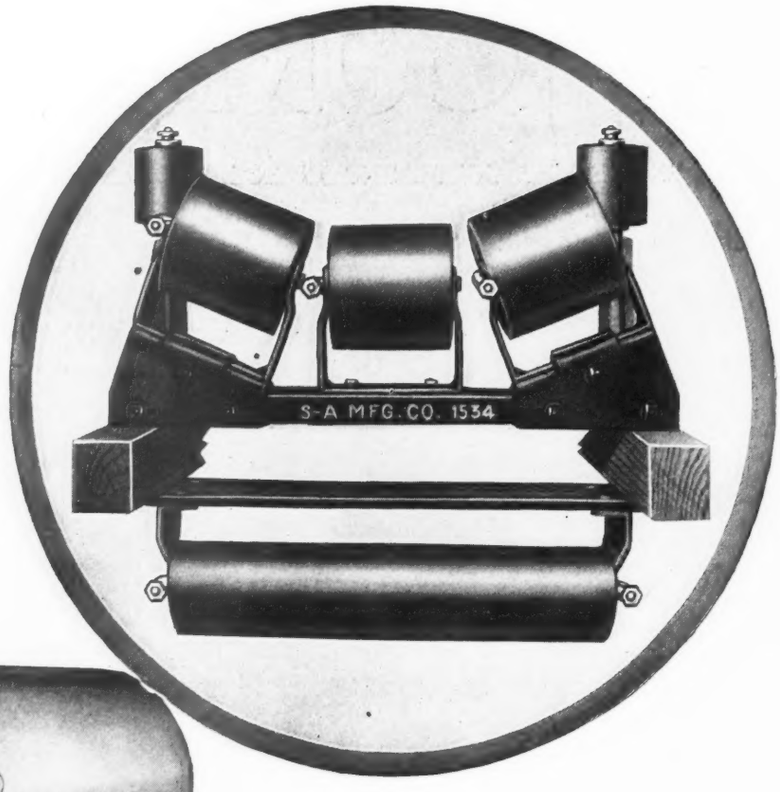
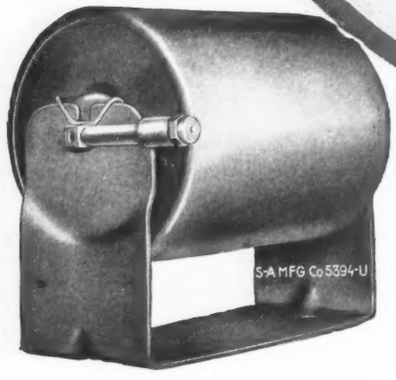
Exploring the Whitewater, British Columbia

By George H. Shepherd

In Arizona's Principal Gold Producing District

—United Eastern's Big Jim Shaft, at Oatman, in Mohave County





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ENGINEERING AND
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JOSIAH EDWARD SPURR, Editor

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Litigation vs. Arbitration

A CORRESPONDENT writes that at the commencement of the last class at the University of California, there were graduated, among the rest, forty lawyers and one mining engineer. He bewails the degeneration of a state that made history and molded an empire in the halcyon gold-mining days of '49 and thereafter. But we must not look backward, but forward. The mining industry is adjusting itself, willy-nilly, to changing conditions. It must cut down its costs, reduce its overhead, mine more ore more cheaply. The element of competition between mine and mine, between organization and organization, becomes more and more a real factor.

Litigation has been very expensive in the mining industry. Most obnoxious, most unnecessary, have been the long-drawn-out apex quarrels, detrimental alike to law, justice, and geology. They are plain evil influences.

The delays and miscarriages of justice due to the litigation system have resulted in a nation-wide movement to substitute arbitration for litigation. Several states now have laws making arbitration a legal method of settling differences; that of New York State makes the award of arbitrators binding beyond appeal to the courts. For arbitration in interstate disputes, or maritime disputes, which do not come within the jurisdiction of any single state, a federal law (Senate R. 1005) has been introduced by Senator Sterling, of South Dakota, and was reported out favorably on May 14 by the Committee on the Judiciary. This bill makes interstate arbitration agreements binding and the awards final.

The Arbitration Society of America, with headquarters in New York, has set up arbitration tribunals which have in two years handled more than 500 cases swiftly and with satisfaction to all parties, and without cost to them. The New York courts are two years behindhand, so crowded are they with cases and appealed cases; but arbitration settles a dispute forever in a day or a week.

Most striking of all is the experience of Will H. Hays in the moving-picture industry. After having ascertained the principle and machinery of arbitration as promoted by the Arbitration Society of America, he set up thirty-one arbitration boards in thirty-one cities, to adjust the myriad disputes of his "infant industry." The general counsel for the industry recently disclosed the result of the experiment. More than 5,000 cases have been settled by arbitration under this plan; besides this, more than 25,000 disputes had been settled out of court because the presence of the arbitration clause in contracts rendered litigation impossible. Most impressive of all was the statement that as a direct result of this prevalence of arbitration there are in the great moving-picture industry today but two cases in the courts of law!

It is only fair to say that this movement is strongly supported by the courts and by the great lawyers. The new Attorney General of the United States was on the Board of Governors of the Arbitration Society of America until his appointment.

We recommend to the mining industry that it cut its overhead by arbitration. The apex law was a mistake and may yet be repealed; but it can never be made retroactive. We hope we have seen the last apex litigation case.

If you are interested as to *modus operandi* write us, and we will put you in touch with the Arbitration Society of America.

Two Incidents in Silver

SILVER MINERS will be heartened by two happenings in the silver situation—one, the rising tendency of the market which carried the price of the metal to the highest level of the year, 66⅞c., on May 22, and the other, the progress of Senator Pittman's special silver legislation through the Senate. Purchases of silver in Europe have been largely responsible for the advancing price and presage the wider use of silver coins which have disappeared almost entirely from circulation on the Continent.

After the Dawes reparations plan is put into effect it is not too much to look for stabilization of the various currencies in Europe, the primary requisite for the restoration of silver to circulation. This should aid the silver market unless some adverse influence works, at that time, to compensate for it.

Silver miners have not much reason for complaint about the price at which silver has sold in the last year. Compared with the general level of prices of the non-ferrous metals, the price of silver is above the five-year pre-war level, which is more than can be said for copper and zinc. Considering the dire predictions that were made for the behavior of silver after the expiration of the Pittman Act, the metal has given a surprising account of itself. It has been steady enough to serve as a currency standard; in fact, measured on a gold basis, the price of silver has been far steadier than the value of the paper franc, the lira, and other European money.

Last week Senator Pittman received the signal compliment of having his bill calling for Treasury Department purchases of 14,589,731.13 oz. of dollar silver unanimously approved by the Senate Committee on Banking and Currency, and having it promptly passed by the Senate. We hope its enactment into law will be expedited so that full justice will be given to silver miners in the United States.

It was a happy thought to take Congressional action in respect of the subsidiary coinage silver which the Treasury Department did not consider a repurchase under the terms of the Pittman Act. The hearings which the Commission of Gold and Silver Inquiry held

last year in investigating purchases under the Pittman Act were helpful in disclosing all the details about the Treasury Department's rôle in that matter, but they did not serve to weaken Treasury officials when it came to rescinding their determination not to purchase the 14,589,000 oz. of subsidiary coinage silver. Senator Pittman cut the Gordian knot by introducing his special legislation. The silver miners can at last expect action.

Flying to the Golden North

WHAT WE BELIEVE is the first regular flying service into a remote mining district has recently been initiated in Canada; prospectors can now get across the trackless bush of northwestern Quebec in faster time than can be accomplished by the wealthy capitalist in speeding from his Long Island estate to his Broadway office.

One of the difficulties that has hindered the development of the mining districts of northern Ontario and Quebec is the lack of means of transportation. In summer it has been difficult to get machinery far from navigable waters, and in winter the rigorous climate is not conducive to much open-air work, though with dog teams practically any district is accessible.

A gold belt extends from the west to Matachewan, Ontario, then crosses the government railway to Kirkland Lake, a producing district, on through Larder Lake, crossing the Quebec boundary, into what has come to be known as the Rouyn district, and thence further east and southeast. A large number of claims have been staked in the Rouyn district, and it is here that the new air service extends.

Hydroplanes of the Laurentide Air Service, carrying five persons, meet all Canadian Pacific trains at Angliers, a station 12 or 15 miles northeast of Cobalt. The trip into the new mining district is one of 47 miles and it is made in forty-five minutes. The fare per passenger is $50, with a baggage allowance of 200 lb. free. For special trips, a plane can be chartered to go 32 miles or less, to carry from one to four passengers, for a total of $150. The price does not seem extortionate considering the time saved and the far greater convenience. Several districts in the United States would appreciate a similar service.

The United States in the Politicians' Hands

THE PROSPERITY of the mining industries depends in the last analysis on the general prosperity. Therefore, it is germane to examine, from time to time, how general conditions stand. Everyone is rushing feverishly to and fro; but contentment and the real enjoyment of life are not conspicuous, if indeed visible. The United States is believed, especially in Europe, to have grown very rich during the last decade: but a recent writer in the *Budget*, published by the National Budget Commission, shows that while the inventory of total wealth is listed at 187 billion dollars for 1913 and 300 billion for 1923, an apparent increase of 60 per cent, yet this is a false comparison, and a case of figures that lie. According to the Federal Bureau of Labor Statistics, it takes $1.64 to purchase commodities that could have been bought for $1 ten years ago. Measured in terms of true wealth, therefore, the total wealth has actually decreased more than six billion dollars. Since the population has increased markedly during the decade, it results that the average individual is distinctly poorer than in 1913.

If this is the tendency we should naturally seek the cause. We must not discount the destructive results of the Great War. Wars are economic maladies for all concerned. The wealth of the world has shrunk, and the United States has suffered, though far less than the other participants. The recent events in Washington point to another cause, too plain to escape the nose of the most careless optimist. We have seen the spectre of a little corporal's guard of men in command of the government standing firm for sound economic policies—a little lone island of statesmen surrounded by a sea of politicians of both parties. It has become clear, even to the primary-grade mind, that the Republican party has one overwhelming principle, which is Votes; and that, by a curious coincidence, the Democratic party stands by the same banner. Statesmen are rare and unheeded in the Senate; and a curiosity in the House of Representatives. It is a strange thing that practically all the measures passed or about to be passed in the present Congress are regarded by the President, in his responsible position, as economically unsound; nearly all aim at further burdening the taxpayers. Worse than that, very many of the members of Congress individually and privately admit this—and yet vote for these measures, under the impression that it will insure their re-election.

Magma

THE CONCLUSION, which is irresistibly indicated by the facts of nature, that ores have crystallized, not from hot or cold waters, but from an extreme type of igneous magma, brings up sooner or later the question as to what is magma. Ninety-nine out of a hundred of the initiate will at once respond: "Magma is molten rock." This is absolutely and fundamentally wrong. Whatever magma is, it is not molten rock. Molten rock is molten rock.

A magma resembles molten rock in much the same way that a jug of milk resembles a Welsh rarebit, or the melted butter that you pour on your asparagus. The milk is a magma: out of it is segregated butter and cheese, leaving the watery part, itself not at all lacking in varied chemical constituents. The cheese is the rock, as the milk was the magma. Melt the cheese, and you get—not milk but a rarebit. The temperature of molten cheese is, moreover, much higher than that of fluid milk.

The rock magma is a fluid in which gases (water gas and others) are an essential component—without this factor there is no magma. The gaseous constituents, together with a moderately elevated temperature, and the solution of one salt in another, result in a perfect state of fluidity for a magma whose volatile constituents are probably always in far less proportion than the non-volatile constituents which solidify out of solution, given the opportunity. This opportunity comes with fall of temperature or release of pressure; the magma disintegrates, and the gaseous components (including water) separate themselves from the rest, which becomes solid, forming rock, pegmatite, or ore.

External pressure is indispensable to the existence of magmas; it is necessary for the keeping of the volatile and non-volatile constituents in intimate association and solution. The magma disintegrates and

dies when the separation takes place—when the rock forms. Nor shall all the King's horses and all the King's men ever restore it to magma again.

Where are the volatile constituents which abandoned the magma when it froze? Where are the snows of yesteryear? Yet it is not only a popular blunder that melting of the rock will recreate its original condition, but a common oversight of scientists—of geologists and chemists and physicists—yea, geochemists and geophysicists. Is there any difference, then, between a magma and a solution? If it is not a melt, is it not a plain solution? The distinction to bear in mind, so far as ore deposits are concerned, is that between waters ("aqueous solutions") and ore magmas, as agents of ore deposition.

A minor quantity of volatile components (including water) suffices to make the magma almost as fluid as water. The pegmatite magmas are more fluid than the rock magmas, and contain more of the volatile constituents. The ore magmas are apparently identical in nature with the pegmatite magmas, and are a variety of them. Theoretically, as has often been stated, solvent and solute are miscible in all proportions; so there should be no sharp line between rock magmas and hot waters.

Geology is concerned, however, not with what might be, but with what is. It is probable that the most fluid pegmatite and ore magma contains more of the solid than of the volatile components, while the most mineral of hot spring waters contains only a small fraction of one per cent of solids. Actually, there seems to be a great gulf fixed between hot spring waters and the most fluid pegmatite and ore magmas. The volatile component of magmas, however, which separates on the freezing out, from the magma, of a rock, a pegmatite, or an ore, is chiefly water, and has a close affinity to hot spring waters.

To be sure, one never saw a magma, and never will. The lava that boils at Kilauea, fluid, almost, as water, is not magma—it is the transition stage between magma and rock. But neither has anyone ever seen a molecule nor an electric wave. Science sees many things that cannot be exhibited to the crowds in the museums; and the lack of ability to touch, taste, see, and handle should not allow the followers of geology to be branded as less adept than those pursuing the other sciences.

A Common Language

THE DIRECTOR of the U. S. Geological Survey is on his way to England to confer with the Director of the mining experimental station at Eskmeals regarding co-operation in the work of the two organizations. The institution at Eskmeals is so far relatively a small affair, with an annual appropriation about half that of the Pittsburgh station of the Bureau of Mines. Coal mining and safety problems are its chief concern for the moment. The urgent request for a co-operative program came from the English institution. This excellent example of co-operation is only another phase to the spirit which sent American destroyers to the aid of the British airmen who were competing with the American airmen in the round-the-world trip. The popular sympathies are with those who are having engine trouble, regardless of the flag.

There is an organization, called the English-speaking Union, founded in London by English, in New York by Americans, which aims to promote courtesies and better understanding among all those who speak the common tongue. It is not a racial union; the British, like the Americans, are a racial mixture; the union is the common language and the more or less common way of thinking and acting. The British Empire, now more and more spoken of as the British Commonwealth, is a group of nations forming a single state, as the Prince of Wales has well put it. As the independence of each nation is more fully emphasized, the ties of language and of tradition become more and more binding. The British Empire Congress, now meeting in London, will serve to bring the antipodeal nations closer together, with a better understanding. The Mining and Metallurgical Congress, which is a part of the general program, will help toward a better understanding of the world problems of the mining industry. Many representatives from the United States, officially representing our mining and metallurgical societies, will be present at these meetings and will be interested in the common problems.

Grapefruit for Breakfast

THE PROBLEM as to what college does for a man has not yet received the attention that it deserves from college professors of psychology. Granted the fundamental truth that education is desirable, the question still arises how far education prolonged into the college years increases or decreases the chances of usefulness and happiness of this and that individual. There is without question a certain class that chiefly bring back a stultifying of the initiative, a taste for refined living, a disinclination for the bottom of the ladder, and for any place at all on most ladders. The world is narrowed for them, so that they are likely to secure most unsatisfactory holds on the industrial and social fabric. They will not descend from the heights of a college senior or post-graduate to the muck of an industrial beginning. Mining schools suffer comparatively little from this tendency; universities and colleges of arts most.

We have observed in some of the great universities that there is a tendency on the part of graduates to maintain all their lives the social and industrial status with which they entered college. The college experience acted as a paralyzing agent—the poor freshmen boys remained poor as a group up to the thirtieth reunion; the rich and influential freshmen became captains of industry. This is, of course, quite contrary to the legend and the oft-blazoned example. We are talking about the rule, not the exception. The exceptions of course are biological accidents, who cleave through all difficulties, including whatever handicap they encounter at college.

In schools of mining the weakening influence may also exist. We once met a group of very young mining engineers at a Mexican mine. They complained of the hardships of the life. It looked like luxury to us, comparatively speaking—abundant grub, a wonderful climate and scenery, room enough; so we were curious. "Well, there are plenty of hardships," the spokesman said. "Now, for example, there's Hardy over there"—pointing to a good-looking boy; "he likes grapefruit for breakfast——." Hardy looked the martyr properly; and there was of course nothing more to be said.

Mining Methods at Gold Hill, Nevada

A Description of the United Comstock's Underground Operations

By George J. Young
Associate Editor

REOPENING of a once-worked mine entails a variety of problems interesting to mining engineers generally. In the instance of the United Comstock Mines Co. at Gold Hill, Nevada, the Gold Hill group of mines was reputed to contain in fills and low-grade ore a substantial tonnage of workable ore. This was ascertained by a system of drifts and crosscuts laid out in conformity with the methods used to develop a virgin orebody. As a result of this exploration, the property in question was taken over by the United Comstock Mines Co., and mining and milling plants were installed and production was started in September, 1922.

The vertical section and plan of the orebody are shown in Figs. 1 and 2. In the vertical section the widest part of the orebody is at the top and is approximately 200 ft.; the narrowest at the bottom, 50 ft., the vertical range being over 500 ft. and the dip reversing from the west at the surface to the east at a lower level. In plan the orebody is lens-shaped; the longest

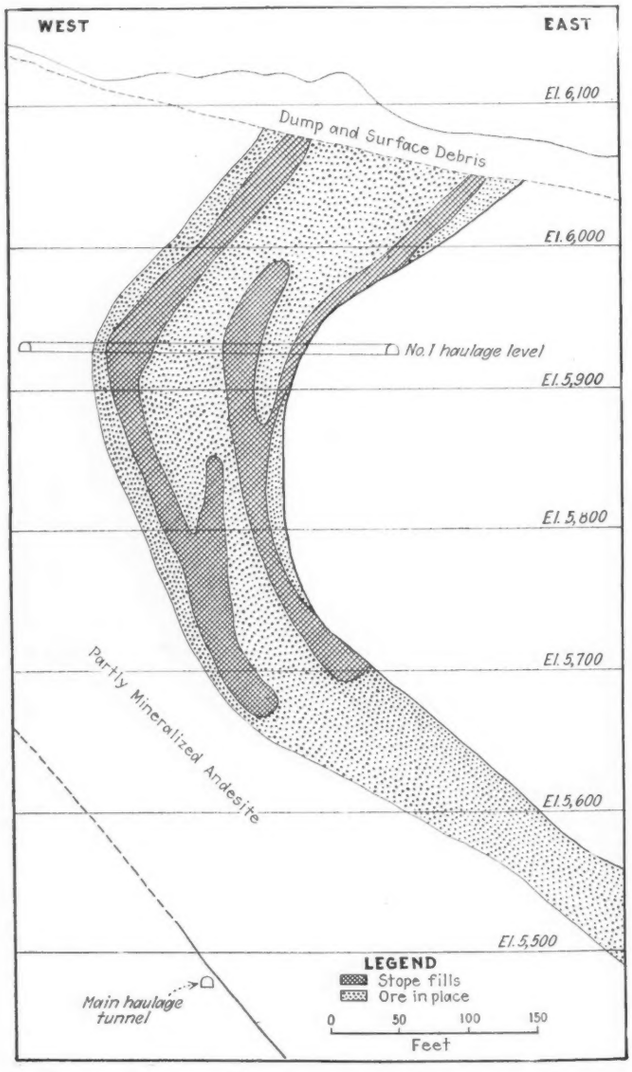


Fig. 1. Cross-section through the Imperial orebody, Comstock mine

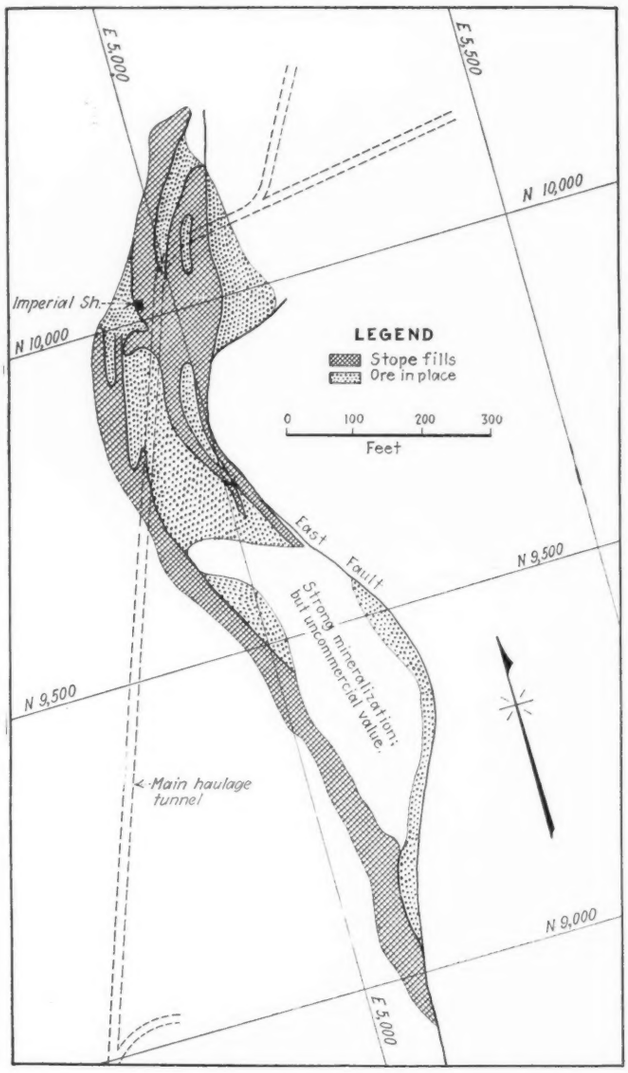


Fig. 2. Typical plan of orebody

axis is approximately 1,250 ft. and the widest about 250 ft. As will be noted in Fig. 2, a considerable part of the lens is designated as "strong mineralization but uncommercial values."

In the vertical section about two-thirds of the ore is in place, and about one-third consists of stope fills. The plan indicates about an even division between stope fill and ore in place. The west wall consists of altered andesite, kaolinized and containing a network of small clay seams. According to W. H. Grant in a paper presented at the San Francisco meeting of the American Institute of Mining and Metallurgy, there is no sharp limit to the ore in the west. The ore in places consists of quartz and a stockwork of quartz and silicified andesite. The quartz is bounded on the east by a fault and an accompanying clay gouge. The wall rock is shattered andesite, kaolinized and with many clay seams. According to the metallurgical examination of the ore, the slime content ranges from 40 to 63 per

cent. This indicates in general a high clay content in fills and to a less extent in ore in place.

The ore contiguous to the surface is earthy, and its clay content when moist or wet results in a more or less plastic mass that is extremely difficult to move through chutes, pockets, or gates. When it comes to rest it must be mined again. When comparatively dry, less than 4.5 per cent moisture, it works quite freely in a relative sense, but its angle of repose is high and it possesses considerable cohesiveness. Under impact it is apt to develop into a tough coherent mass that presents a difficult problem.

Ores Siliceous in Lower Orebody

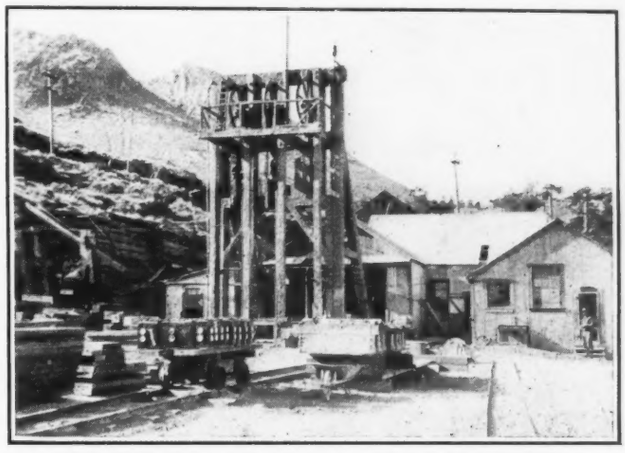
The old stope fillings are crushed and decomposed and are mixed with heavy gouges and decayed timbers. Thus there was little to choose between the general run of the near-surface ore and the deeper stope fills. The siliceous ores are, however, different in physical characteristics and can be more easily handled. In the lower part of the orebody they constitute the greater proportion of the ore. The mining and milling of these ores does not involve the difficulties presented by the more earthy ores, and as a consequence the operating costs should be appreciably lowered when they are mined.

The first plan of development was described by John R. Reigart. A main haulage level and adit 8x8.5 ft. in the clear was constructed in the footwall connecting with the mill site in American flat. This reached a depth below the surface of about 700 ft. in the Imperial shaft, and it is approximately 1,000 ft. above the Sutro tunnel south lateral. The adit is 9,250 ft. long, more than two-thirds being timbered. Three intermediate haulage levels were established at from 175 to 190 ft. apart. Three ore passes designed to pass the ore from the intermediate to the main haulage level were constructed as incline raises in the footwall. The angle of inclination varied from 60 to 76 deg. These passes provide a manway compartment 2x6.33 ft. and a chute 4.5x6.3 ft. The chute is constructed of 10x10-in. timbers, cribbed. Between the cribbing 10-in. blocks projecting 3 to 4 in. beyond the cribbing line are inserted. On the manway side holes are provided every 10 or 15 ft. for barring. The general layout for an intermediate level at first consisted of foot- and hanging-wall drifts connected by crosscuts at 55-ft. intervals. The ore passes connected with the west drift.

Two mining methods were described in 1922 by John R. Reigart. The southern end of the ore zone was attacked by a system of surface mill holes connecting with the upper intermediate level. The north end of the ore zone was to have been undercut and won by caving, successive blocks to be worked from the top down. Where possible, the remaining ore was to be worked also by a caving method.

As might have been expected, changes became necessary after several months' operation. Considerable trouble was experienced with the main ore chutes, due to the ore arching and hanging up. Offsets in the line of the chute added to the difficulty. Flat steel ropes were installed in the chutes in an endeavor to facilitate downward movement, but this expedient proved unsatisfactory. The success of the enterprise, in part at least, was predicated on maintaining tonnage at a high point, but the "bottle neck" that developed seriously interfered with the expected program. Lubrication of the ore by water was out of the question, as the coarse-crushing division of the plant was designed for dry crushing.

Moisture in the ore was about 5 per cent, but this was localized in the clay material, resulting in a material that would pack and consolidate under impact. To overcome this difficulty a two-compartment transfer winze was constructed. This was at a 70-deg. angle of inclination and was equipped with two eight-ton skips operated in balance and controlled by multiple-



Yellow Jacket shaft and sublevel adit portal

grooved sheaves and hand brakes, the control arrangement being the same as used for gravity inclines. The skips are circular in section and are provided with bottom-discharging doors.

Loading and receiving bins were constructed, and all of the ore was lowered from No. 1 intermediate level to the main haulage level. In this way the "bottle neck" was removed, although in the effort to produce a high tonnage the grade of the ore appears to have been lowered materially.

Dilution in the Mill Holes

The surface mill holes started at the southern end of the orebody were satisfactory in part, but dilution

Mill holes at north end of orebody

of the ore took place. The surface mill holes over the north end, near the Imperial shaft, which were started to obtain tonnage, also contributed low-grade material, as much of the surface débris and old waste dumps had to be worked off, and this, instead of being dumped as it should have been, was sent through the mill.

No. 1 subhaulage level and the sublevel immediately

above are shown in Fig. 3. This sublevel connects with the mill holes and the subhaulage level. In the south-end open pits, at the time of my visit, no men were working, as the west wall of the pit was actively caving. In the open pits near the Imperial shaft on the north end miners were at work undercutting the mill holes. A scraper operated by main and tail ropes was also in use, scraping fine material to chute openings. A considerable tonnage was thus won.

In the initial development layout, crosscuts were driven, connecting foot- and hanging-wall drifts as shown in Fig. 3. As will be noted, each crosscut requires curved turnouts, thus necessitating heavy timbering at these points. As heavy ground was encountered, the turnouts required considerable attention. They also proved unsatisfactory for the subhaulage trains, as the Granby type car dumps only on one side.

In planning the lower subhaulage levels the crosscuts

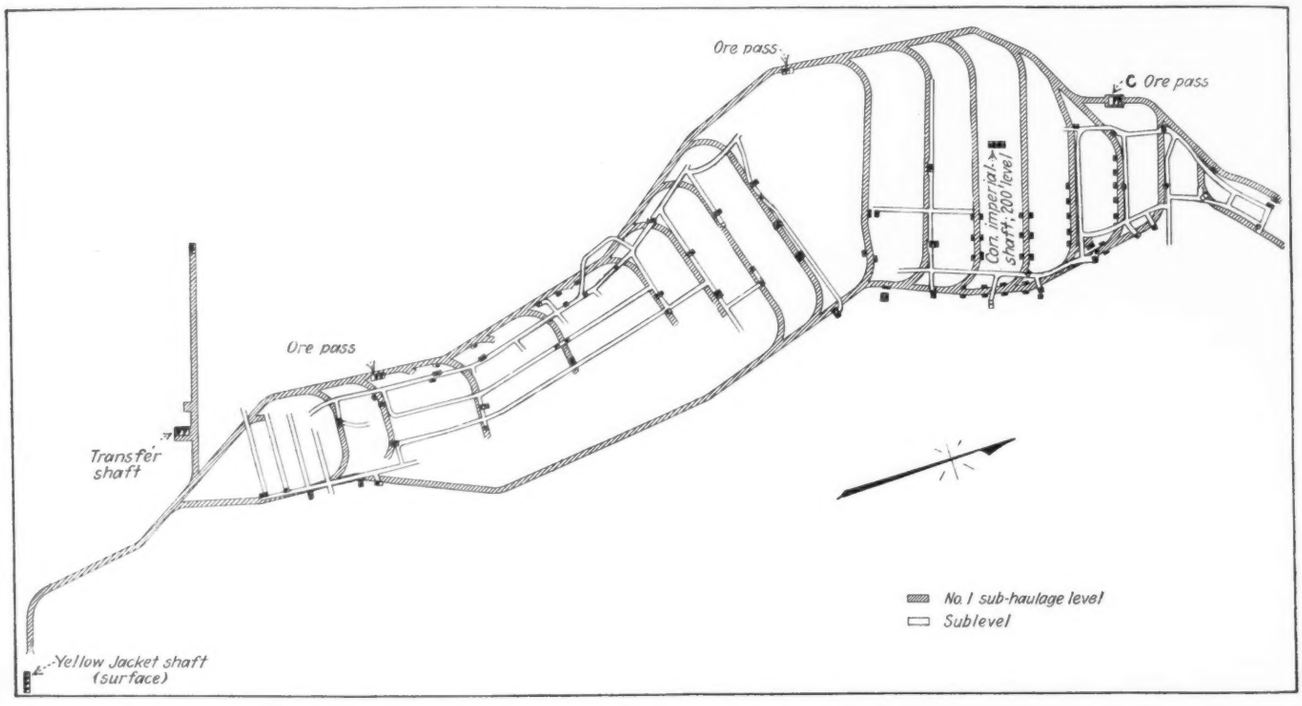


Fig. 3. Plan of No. 1 subhaulage level and sublevel immediately above

As an outgrowth of the preliminary underground mining, a mining method was finally decided upon. The principal features of this are indicated in Fig. 4 and Fig. 5. In Fig. 5, two motor drifts are shown. These are timbered with "pony sets" above the regular sets, and connecting with these on either side are short raises inclined at 50 deg. These raises are cribbed and serve as a chute and manway.

At the top of each chute a grizzly is placed. Heavy lagging protects the top of the raise. Short branch raises start from the sides of the upper set and terminate at the undercutting level, which is 31.5 ft. above the rail level. The center-to-center distance between these side raises is 12 ft. The raise spacing is 15 ft. center to center. Thus the bottom of a block which is undercut by drilling and blasting from the short raises above the grizzly is served by a number of draw points spaced 12 ft. center to center in one direction and 15 ft. center to center in the direction at right angles. Two drifts, spaced 50 ft. center to center, would serve for a width of orebody of approximately 100 ft. For a length of 100 ft., 56 draw points would be necessary (one for each 180 sq.ft.). There would be 28 raises, 28 grizzlies, and approximately 30,000 cu.ft. of excavation above the motor drifts, and, including the motor drifts, 46,000 cu.ft. of excavation. For a cube of 100 ft. width, length, and height, the ratio would be slightly less than 22 cu.ft. of ore for 1 cu.ft. of development.

are discarded as far as possible and parallel drifts are driven from which to command the block immediately above. This arrangement has apparently simplified the application of the method and has facilitated handling the ore. In addition, some of the crosscuts already driven are being utilized as hand tramming drifts. The ore chutes and connecting raises start at slightly above car height and are closely spaced. The ore cars are trammed by hand to short ore passes connecting with the subhaulage level. Motor drifts are timbered with a 6-ft. 12x14-in. cap and 8-ft. 12x12-in. posts, battered, Hand tramming drifts are timbered with 4.5-ft. 10x12-in. cap and 7.5-ft. 10x10-in. posts. Eight by eight inch bridges supported on 8x8-in. blocks are used on each set.

Wall Rocks Mix With Ore

The undercutting and caving method as applied to an orebody of the type described raises a number of questions as to the results that will be obtained. Particularly, there is the question of dilution by wall rocks. Will the ore blocks fan out as the cave extends upward, drawing in barren rock to the chutes, or will the cave restrict itself to within the limits of the walls? This will depend upon the solidity of the walls as compared with the filled stopes and vein rock. Undoubtedly, after movement has shattered the vein material, and although the filled material has become compact to a remarkable extent, due to its clayey nature, it is, as a mass, weaker than the inclosing country rock. Thus it would appear

that the cave might confine itself within the limits of the walls and capture only those parts which have become badly shattered.

Will the areas started around each chute fan out sufficiently to capture the whole orebody or will the cave tend to draw in and pipe up like an inverted funnel? The close spacing of the draw points would appear to indicate that they would yield the full width of the orebody under sufficient top pressure. It seems that the physical conditions are such as to predicate a considerable degree of success for the method. However, the spacing of the subhaulage levels is a controlling factor. As was noted, these are from 175 to 190 ft. apart. The experience gained upon the upper levels will determine whether a closer spacing is necessary. So far mining has not progressed sufficiently to determine this factor. If excessive dilution develops, apparently the only recourse is a closer spacing of the sublevels. The shape of the orebody, its narrowing down with depth, also predicates a closer spacing of sublevels in the deeper portion. This would increase the development cost.

It should be noted that the mining method described requires the least amount of timber and this only for

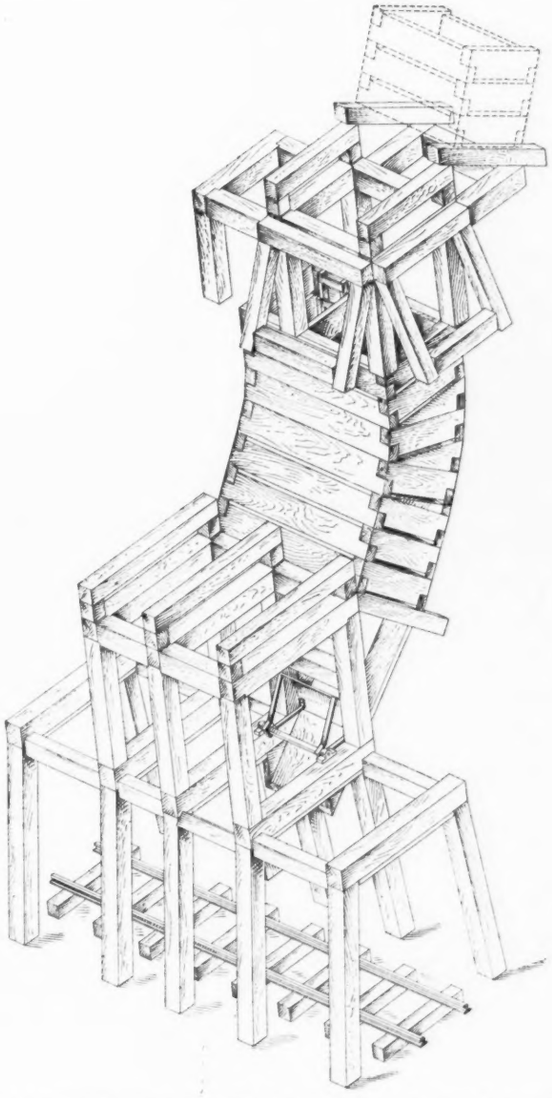


Fig. 4. Timbering detail of ore chute and undercutting chamber

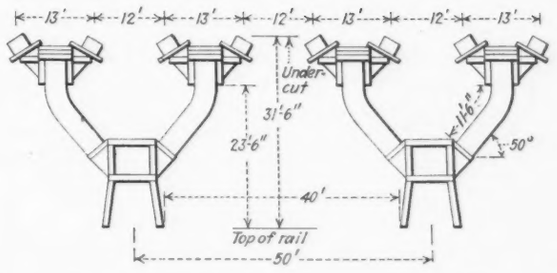


Fig. 5. Arrangement of raises and undercutting points

accessory structures. Top slicing, an alternative method that would have prevented dilution, necessitates a generous use of timber and would undoubtedly have been more costly.

An adequate appreciation of the mining difficulties was lacking at the beginning of operations, and, as stated before, the "bottle necks" that developed in the mine reduced the tonnage to one-half that expected, and this was won at a prohibitive expense. Likewise, the grade of the ore proved disappointing. Men, methods, and equipment were changed, and the tonnage was raised finally from 45 to 90 per cent of full capacity.

Under J. P. Caulfield, Jr., mine superintendent, a system was worked out for controlling the grade of the ore sent to the mill. The method follows the practice developed in the porphyry copper mines. A series of charts were prepared, one for each ore block. Each chart shows a vertical longitudinal section of the orebody on cross-section paper. As the outline of the orebody varies, each block presents a separate problem. A line of chutes is referred to as an individual chute. The stope engineer proportions the draw tonnages so as to keep the top of the caved ore on a horizontal plane. Shift reports are required in detail, indicating the estimated draw and the actual draw. These are prepared by the shift bosses. The motor man reports the number of cars drawn from a chute. Four estimates of the ore actually drawn are obtained, the draw boss's estimate, the two-ton car report, the eight-ton skip loads, and the ten-ton carloads, handled in the adit. The mine weights are checked by the weightometer at the mill, so that an accurate weight estimate can be figured back. The development of a chimney in drawing from any ore block is controlled by rapidly drawing the adjacent chutes on all sides.

Each draw chute is sampled every other day by a grab sample taken across the width of the chute during the time the raise is in ore. When waste begins to appear, samples are taken daily. At the transfer ore pass a shovel sample is taken from each car loaded. These samples are combined in proportion to the tonnages drawn from different blocks, and thus a mine sample is obtained as a comparison against the mill heads. It is of interest to note that the system of mining control enabled the grade of the ore to be raised almost enough to compensate for the drop in the price of silver at the time when the Pittman silver price ceased.

Underground Equipment Adequate

Ore is hauled on the sublevels by storage-battery locomotives. A 2- to 2.5-ton Granby-type self-dumping ore car is used upon 30-in. track gage, 40-lb. rails. Six storage-battery locomotives are in use, four four-ton General Electric, one two-ton Mancha, and a one-ton

(used on the surface plant at the Yellow Jacket surface tunnel). Each locomotive is provided with two trays of storage batteries, which are charged alternately, thus keeping the locomotives in continuous service.

Underground the Granby cars are handled in trains averaging about twelve cars, each train being manned by a motorman and a trip rider. The cars dump upon a flat grizzly constructed of 60-lb. rails, 12-in. openings. A bulldozer is stationed at the grizzly and handles as far as practicable the oversize pieces by sledging and blasting. The cars tilt at an angle of 40 deg., and more or less barring is done by the trip rider and bulldozer. The usual time required to dump a twelve-car train is from two to three minutes, but sticky ore increases this to double or more. The storage-battery locomotives in a representative month required 0.444 kw.hr. per dry ton milled.

The ore is loaded from a small pocket beneath the grizzly into a loading pocket above the main haulage level by eight-ton skips, of which there are two, operated in balance in the 70-deg. winze. The skips are cylindrical in section, tapering from 4 ft. in diameter at the top to 4 ft. 4 in. at the bottom. The door at the bottom is operated by the bail in such a way that the contents can be discharged as a solid plug of mud if necessary. Under some conditions it has been found necessary to drop the skips upon the landing chairs at a considerable speed to insure the dumping of the contents. The skips are suspended upon 1.5 in. 6x19, plow-steel cables, which are wound around two 7-ft. brake sheaves at the top of the winze. Each sheave is provided with two brake drums, 7 ft. in diameter by 8-in. face. The bands are 7.75-in. by $\frac{3}{16}$-in. plate lined with hardwood blocks 2.5 in. in thickness. Raybestos fabric is attached to the blocks by copper bolts, giving a wearing surface of 0.75x8 in. Wear on the Raybestos fabric after lowering 400,000 tons was slight.

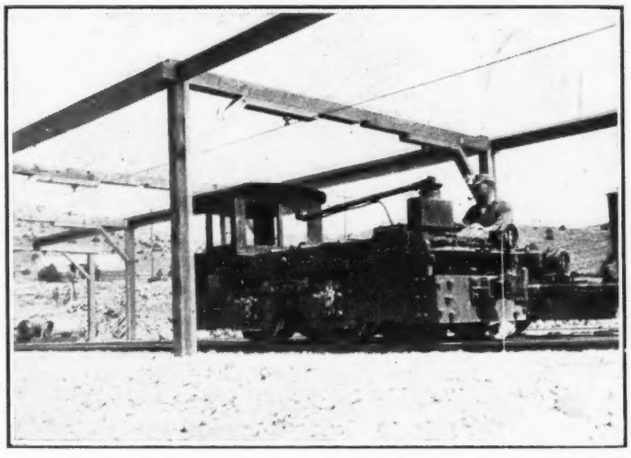
Two of the brake bands are operated by hand wheels, the other two brakes being held in the on-position by one-ton counterweights and released by compressed-air cylinders controlled by a Westinghouse "straight-air" locomotive brake throttle. Either pair of brakes can hold the load, but the operators prefer the use of the air-controlled brakes. It is planned to equip one of the hand brakes with air control and to use it to reduce the heat generated at the brake surfaces.

The skip run is 375 ft. and is made in from fifty to sixty seconds. The loading is done by measuring pockets with air-operated gates. The sticky nature of the ore makes the loading pockets of doubtful value. A compressed-air blow gun ($\frac{1}{2}$-in. pipe on a hose) is used to move the ore when it sticks at the chute gates.

Undercutting craters

Brakes and chute gates are operated from a platform 30 ft. below the subhaulage level. The capacity of the unit has not been fully tested, but B. P. Little, who designed the installation, says that a capacity approximating 6,500 tons per twenty-four hours was maintained for one hour. The cost of downward ore transfer is said by Mr. Little to have been 2.75c. per ton, including all repairs and maintenance. Two men per shift are required for the operation of the transfer unit. Plans were subsequently made for the construction of a second transfer equipment in the Imperial shaft from No. 2 subhaulage level, but these were changed and an ore pass was substituted.

The elevation of the mill tipple on the main haulage adit is 5,443 ft., the track grade is 0.5 per cent in favor of the outgoing loads; track is 30 in. gage, with 60-lb. rails. Ten-ton cars are hauled in trains of ten cars by eight-ton trolley locomotives. The average train load is 99 tons. Wood waste of all kinds is an appreciable portion of the material handled, and its removal at the coarse crushing plant costs from $25 to $30 per day. Usually two trains are operated, each with motorman and trip rider, one train being used for ore transportation and the other for handling waste and materials required in development on the adit level. The operating crews run the loaded trains to the tipple and uncouple and pick up a train of empties and return, the time interval at the outside terminal being about ten minutes. Granby cars are used on the waste train and solid-bottom cars on the ore train. The mill train crew dumps and switches the trains. Main haulage power consumption amounts to 0.5 kw.hr. per dry ton milled, including current for the work train and switching at the tipple.



Trolley type of electric locomotives used in ore haulage

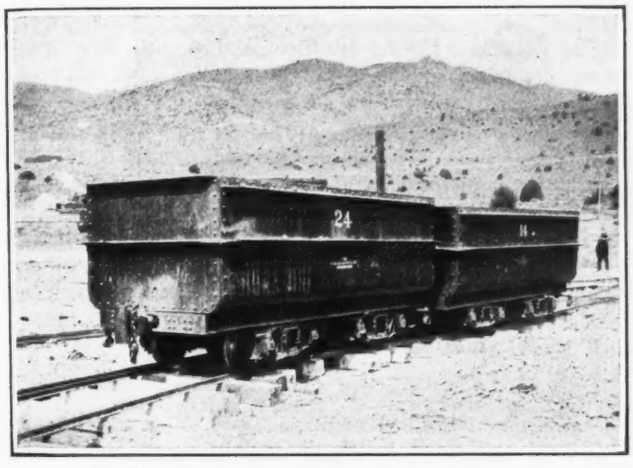
The total power requirement of the main and subhaulage systems, according to Mr. Little, is 0.95 kw.hr. per ton of ore, which is approximately 19.6 per cent of the total mine power requirement of somewhat less than 5 kw.hr per dry ton milled. The remaining 80.4 per cent is divided among air compressors, hoisting, and miscellaneous uses.

The sampling of the orebody and fills was thoroughly done by crosscuts from drifts on three levels. These

crosscuts were placed at intervals of 100 ft. and in some instances at 50 ft. Cut samples were taken and bulk samples of a ton weight also. Slices from the entire length of certain crosscuts were taken. A mill run of 100 tons was made and the bullion was recovered. The method used follows the practice established by experience with virgin orebodies. Whether it would be sufficient in the instance of a large proportion of filled stopes is an interesting conjecture that can only be answered by the results obtained in mining. I am told that the unit value taken for the silver content was the Pittman price, although allowance was made for the possible discontinuance of that price in the future.

Many Early Difficulties Now Largely Overcome

Dilution by waste and low-grade material was and will be an important consideration. The opinion has

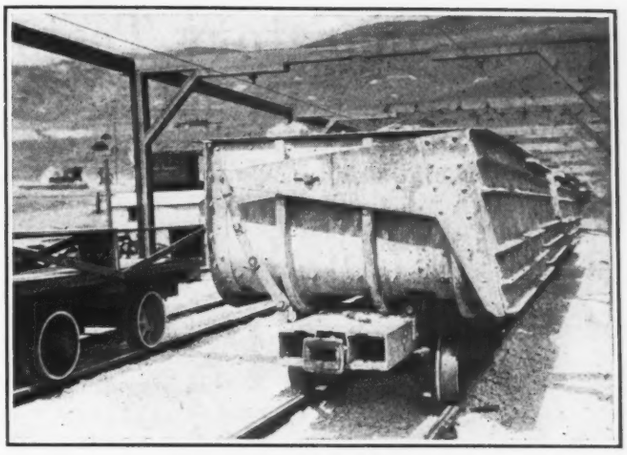


Solid-bottom cars used for ore haulage

been advanced that much of the dilution in the early mining stages could have been avoided had the mine been ready for production at the expected rate. Undoubtedly the enterprise encountered many initial difficulties incident upon inducting a new plant and developing a well co-ordinated operating personnel. Many of these difficulties have been overcome, and no doubt technical information of considerable value will be forthcoming that will answer the question of the extent of dilution that has resulted under the specific conditions as well as the relation between recovered metals and the amounts estimated from the sampling. In addition, valuable experience will be gained in the handling of sticky, earthy ores that will be of use to engineers confronted with similar material in other mining districts.

Profit on Low-Grade Ore Only Possible by Modern Large-Scale Operations

According to Becker, the Gold Hill group of mines produced $86,228,508 from 1859 to 1880. The ores mined totaled 2,455,042 tons, of an average value at the time of $31.05. The present value of an ore of the average grade indicated would be approximately $22.64. The grade of the ore mined by the United Comstock is said to range between $4 and $5 at present prices of silver. Thus the present-day miner is handling ores of one-sixth the value of those handled by the historic miner. The crumbs in the nest of the older miner are all that is left. Modern methods and larger-scale operations have made possible a reduction of the operating costs at Gold Hill to a figure sufficiently low to yield an operating profit. As far as Comstock conditions are concerned, a record in low-cost production has been achieved.



Granby cars used in the mine

Acknowledgment is made of the courtesy of R. H. Hardy, who was manager at the time of my visit, and of John P. Caulfield, Jr., mine superintendent. B. P. Little gave me much information about the mechanical details.

Several Radium Occurrences in Mexico

Vanadium minerals have been found in San Antonio, Pachuca, Mexico; in the Mina district south of Huetamo, Michoacan; in the State of Guerrero; and principally at Placer de Guadalupe, Chihuahua, where ores of great radioactivity have been discovered, says *Greater Mexico.* The Placer de Guadalupe is 75 miles to the northeast of Chihuahua City. The water from this mine is radioactive, and some carnotites containing about 6 per cent of uranium have been deposited on the surface. The pitchblende of that belt contains 80 per cent of uranium. The radioactivity of the ores from Placer de Guadalupe has been studied by the Geological Institute of Mexico and also by the Department of Industry. From these tests it has been found that the radioactivity is as high as 0.04348 electrical units. Strips of cloth saturated with the concentrates of the ores make very strong and clear photographic impressions on sensitive plates in less than seventy-two hours.

Production of Famous Silver Camps

The average mining engineer, if asked to name the district that has produced the most silver, usually thinks of Cobalt, or the Comstock district, though he feels that possibly some of the Mexican or South American camps may have been greater producers if one goes far enough back into history. As a matter of fact, they have produced considerably more, according to the following figures recently published in *The Financial Post:*

Locality	Silver Production Metric Tons	Years
Potosi, Bolivia	30,000	379
Guanajuato, Mexico	15,000	366
Zacatecas, Mexico	14,000	284
Cobalt, Canada	10,600	20
Freiberg, Germany	5,243	733
Comstock, Nevada	4,820	30
Pachuca, Mexico	3,500	379

The Potosi district has produced silver to the value of about $650,000,000 at current prices.

Laboratory Tests for Chloride Blast Roasting and Leaching

Important Factors Include Size of Crushing, Degree of Temperature, Time of Contact, and Percentage of Salt, Sulphur, and Carbonates

By Theodore P. Holt
Metallurgical Engineer, Pulacayo, Bolivia

Theodore P. Holt

LITTLE has been published on the subject of chloride blast roasting and leaching since Mr. Keep's excellent article prepared in 1915.[1]

Since then much experience has been gained in treating various ores and in checking laboratory results with mill operations. A detailed description of the laboratory methods now in use should be of interest, especially to metallurgists experimenting on this and similar methods of ore treatment. I will therefore give in detail the practice as now followed, the method of analysis used, and some metallurgical notes bearing on the adaptability of ores in general to this treatment.

Preparing the Test Charge

For preliminary laboratory tests a representative sample of 150 to 200 lb. of the ore is desirable. This is crushed to ¼ in. and quartered down in the usual way for the head sample. Aside from the usual determinations, the sample should be run for "fire" sulphur and carbon dioxide (analysis given later). Assuming that the sulphur determination shows 4 per cent sulphide sulphur (roughly equivalent to 2.4 per cent of a good grade of coal), 1 per cent more sulphur or 0.6 per cent coal should be added to obtain the proper chloridizing temperature. Also, 8 per cent of salt should be added and the charge ground to 1/10 in. It is then well mixed and water added until the ore will just adhere slightly when pressed in the hand. The desirable amount of water will vary from 5 to 12 per cent, depending on the character of the ore; the best amount will require some experimentation.

The Test Roaster

Various types and sizes of roasting furnaces have been tried out, as well as numerous methods of igniting the charge. I find the type of furnace shown in Fig. 1 very satisfactory. It has the advantage of simple construction, and can be operated anywhere if air at 2 oz. pressure or over is available.

The operation is as follows: First, the combustion chamber is half filled with wood cut to ½-in. size. The fire is started with a little fuel oil and a light blast through the valve *A*. The screen and roasting chamber are put in place, and the joint is sealed with a little plastic clay. Valve *A* is now opened further, the fire being urged until the screen is red hot. The blast is then reduced and the charge quickly added. Then the blast is again slowly increased, until the smoke rises slowly from the surface of the charge. After about one minute, *A* is closed and valve *B* is opened, the adjustment being judged, as before, by the smoke. Some prefer a water gage on the firebox for the air adjustment, but as the resistance of every charge varies, this is of limited value. On an average ore crushed as above described, anywhere from 2 to 5 in. water pressure is required. The roasting zone should reach the surface in from forty minutes to one hour.

The roasting cylinder is then moved to the side of the firebox and lifted from the charge, which will adhere sufficiently to stand alone. The sides are scraped off and the top half of the core is taken for the leaching tests. This part of the charge will be found to approximate the calcines of the commercial furnace.

Leaching Tests

Percolators similar to those used in the old-time cyanide plants serve well for the leaching tests. Ten 2½-liter acid bottles with the bottoms cut off and mounted in a suitable frame make a satisfactory laboratory unit. They each hold a kilogram of charge, allowing ample room for solution. Cheesecloth over a perforated wooden disk gives a satisfactory filter. The rate of solution flow is best regulated by a small screw clamp. The leaching period varies from two to six days.

Battery jars holding slightly over two liters receive the solutions from the percolators. These should be marked at the one- and two-liter level, for convenience in

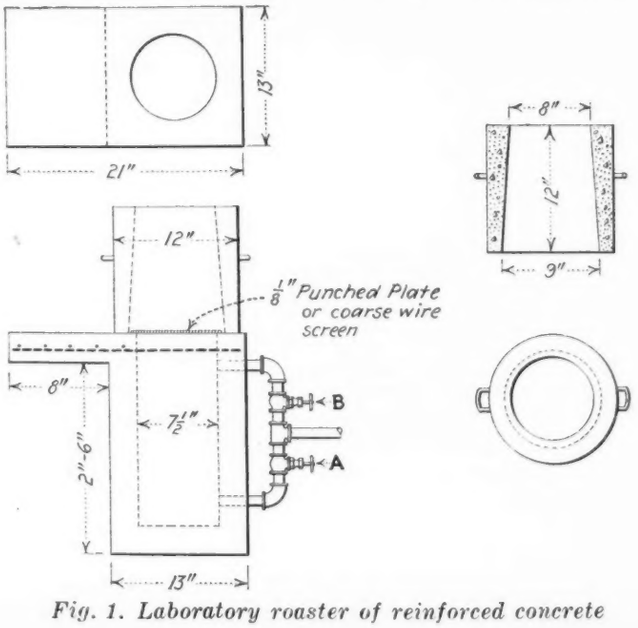


Fig. 1. Laboratory roaster of reinforced concrete

[1] *Engineering and Mining Journal*, Feb. 6 and 15, 1915.

measuring the solution. A half-dozen ten- or twelve-quart enameled buckets are convenient for handling the solutions.

The roasted sample is broken to ¼ in. or so and a head sample cut out. Avoid contact with iron, as this will dechloridize the sample. One kilogram of the ore is weighed into a percolator and leached with from 6 to 20 liters of acid-chloride solution, carrying 5 lb. per ton of sulphuric acid and about 22 per cent of salt. In mill operations the temperatures of the leaching solutions vary greatly, especially where no effort is made to keep the solutions hot. When sluicing the calcines from the roasters the solution reaches the boiling point, whereas near the lower end of the iron boxes it may be as low as 20 deg. C. About 30 to 40 deg. C. is satisfactory for laboratory tests. In general, the higher the temperature the shorter the leaching period required.

The time of treatment will likewise vary from two to six days, depending mainly on the grade of the ore. If a high lead recovery is sought, it will be well to raise the salt content of the leaching solution close to saturation. If the ore is high in silver, some care is necessary, as the solubility of the silver is depressed, and a low extraction may result. If the ore carries no copper or soluble iron, a little ferric chloride will often improve the silver extraction. In mill practice iron enters the solution as ferrous chloride in the scrap-iron boxes, and is oxidized by contact with the air to ferric chloride.

It is well to measure 100 c. c. of solution from each two liters of the effluent as a solution sample. The solution should be thoroughly mixed and kept in a stoppered bottle. This gives a good check on the head and tailing assay, which is used as the basis of extraction.

Variation Factors in Roasting

The leaching test is washed with ½ liter of water, dried, weighed, and assayed. The assays are corrected for the loss of weight in leaching, and this corrected tailing plus the solution should equal the head within experimental limits.

It is well to vary the size of crushing in roasting charges from four mesh to twenty mesh. Then, keeping the size factor constant, vary the percentage of salt. Also, the percentage of sulphur and the temperature are other factors to be investigated.

If the ore is low in carbonates, and carries 3 per cent or more of sulphur, it will be safe to assume that the roasters will produce ample acid for leaching. Otherwise the condenser can be connected and the acids collected in a given volume of chloride solution.

Variation Factors in Leaching

Except with lead ores, where a nearly saturated chloride solution is desirable, a solution testing from 20 to 24 deg. is satisfactory for leaching. Acid may be varied up to 1 per cent. Acid chloride solutions are active solvents of native silver, silver sulphide, and other compounds, which accounts for the superior recovery obtained compared with that when using hyposulphite solution.

The effect of temperature, time of contact, and presence of cupric and ferric salts are other factors to be studied. The re-use of a precipitated solution will often show a higher recovery than a fresh solution.

One of the percolators as used for leaching also makes a very good scrap-iron precipitator. The small iron or steel lathe-turnings should be packed to a depth of 6 in. and the flow of the solution regulated by a small screw clamp. The solutions from the leaching tests are passed through at a rate to give fairly complete precipitation.

After 100 grams or so of the product has been secured it is cleaned up and a sample washed and dried for assay. About 50 grams of the undried product is transferred to a 2½-liter bottle and agitated with pregnant solution from the leaching tests. The product is allowed

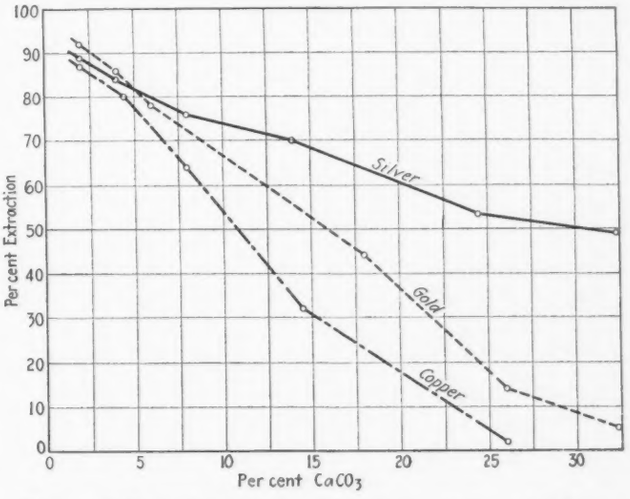


Fig. 2. Effect of calcium carbonate on the gold, silver, and copper recovery

to settle, the barren solution decanted, and fresh silver solution added. This operation is repeated until the silver fails to precipitate. It is then filtered and washed and dried for assay.

The progress of the precipitation can be determined by diluting a sample of the solution with five volumes of clear water, the density of the silver chloride precipitate formed indicating the quantity of silver present. If much lead is present it will be necessary to allow this to settle before the silver chloride can be observed.

The results of a recent precipitation test of this kind are given below:

	Scrap-iron Precipitate	Silver Precipitate
Silver, oz. per ton	3,693.5	22,262.0
Copper, per cent	54.3	2.9
Lead, per cent	13.8	Trace

The silver precipitate is easy to reduce to fine doré bullion. If it is desired to carry this test further, the decanted solution can again be passed through the scrap-iron precipitator, or a small electric cell, and the remaining metals recovered.

Salt Consumption

The principal reagent used in chloride roasting and leaching is common salt. It is found necessary to carry from 5 to 15 per cent in the roasting charge, and often this is a heavy item of expense. In many instances I have found that the salt actually consumed is a very small part of the amount necessary in the roasting charge for good chloridization. It is therefore feasible under some conditions to recover this unconsumed salt from the waste mill solutions and return it to the roasters.

The salt consumption determination consists in dissolving the soluble chlorides with warm distilled water from the roasted calcines, and determining the chlorine by a standard method. The water-soluble chlorine may be assumed as being available for chloridizing and fig-

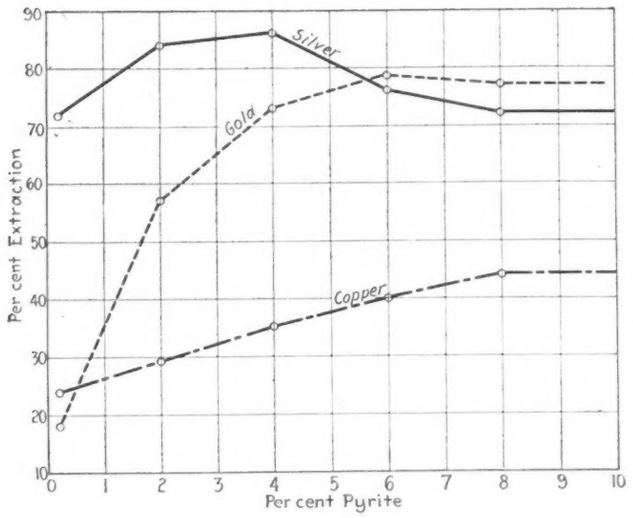


Fig. 3. Effect of increasing the percentage of sulphur, with 4 per cent calcium carbonate

ured as sodium chloride. The change in weight in roasting must of course be taken into the computation.

One ore upon which a complete series of tests was run, recovering the salt from the waste solution by solar evaporation, gave the following rather remarkable result:

Roast A. New salt (98 per cent NaCl) gave 4.3 per cent NaCl consumption.

Roast B. Evaporated mill solution (83 per cent NaCl) gave 1.1 per cent NaCl consumption.

The silver and copper recovery for Roast B was slightly higher than for Roast A. The chemical mass action in the roasting charge, it would appear, is responsible for the decrease in the salt decomposed. In other words, the presence of sodium sulphate in the roast limits the further decomposition of salt.

Limestone and Similar Carbonates

Limestone and similar carbonates are the chief interfering minerals to chloride roasting and leaching. Their effect on the recovery of the metals is readily seen by reference to Figs. 2, 3 and 4. Fig. 2 shows the effect of an increasing percentage of calcium carbonate on the gold, silver, and copper recovery. Here the sulphur content of all roasting charges was 3 per cent. A similar series of tests on a silver-lead ore gave a lead curve slightly above the silver curve.

Fig. 3 shows the effect of increasing the sulphur in the roasting charge, all the roasts carrying 4 per cent calcium carbonate.

Fig. 4 shows a similar series in which all of the roasts

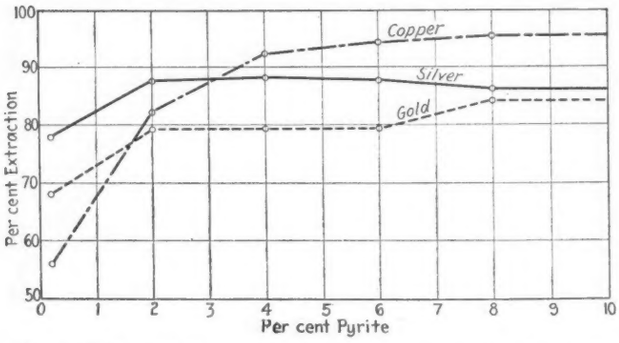


Fig. 4. Effect of increasing the sulphur, with 8 per cent calcium carbonate

carried 8 per cent calcium carbonate. The reason for the peculiar form of the silver curve in this case is obscure, but another series of experiments checked the first results closely. A double roast with this percentage of calcium carbonate present brought the recovery up to 90 per cent, showing that it is possible to sulphate the carbonates present effectively if sufficient sulphur is available.

In the metallurgical control of the mill, and also the laboratory experimental work, certain analyses and methods of assay have been found useful. These have been developed by the chemical staff of the Tintic mill and the Tintic Standard plants, and the Salt Lake station of the Bureau of Mines. So far as I know they are not available for reference, so I include them here.

The Fire Sulphur Assay

In the control of the roasting furnaces it is very important that the operator know the calorific value of the ores entering the charge. This determination consists in finding the reducing power of the ore on lead oxide. The stock flux is made up as follows:

Sodium carbonate, 10 lb.

Litharge, 25 lb.

Borax glass, 5 lb.

Use 10 grams of ore and 90 grams of the above flux when the sulphur is estimated to be less than 10 per cent. When over 10 per cent increase the litharge in the charge gradually to a maximum of about 50 grams. For ores containing over 25 per cent sulphur, cut the ore sample to 5 grams. Fuse for forty-five minutes, increasing the temperature gradually as in the standard lead assay. The calorific value of the lead button in terms of fire sulphur is given in the following table:

California Value of Lead Button in Terms of Fire Sulphur

Grams Pb	Per Cent S	Grams Pb	Per Cent S	Grams Pb	Per Cent S	Grams Pb	Per Cent S
1.0	0.4	9.5	4.2	18.0	8.1	26.5	12.0
1.5	0.75	10.0	4.5	18.5	8.3	27.0	12.1
2.0	0.90	10.5	4.7	19.0	8.6	27.5	12.3
2.5	1.2	11.0	5.0	19.5	8.8	28.0	12.6
3.0	1.4	11.5	5.2	20.0	9.0	28.5	12.9
3.5	1.6	12.0	5.4	20.5	9.2	29.0	13.1
4.0	1.8	12.5	5.7	21.0	9.5	29.5	13.3
4.5	2.0	13.0	5.9	21.5	9.8	30.0	13.5
5.0	2.25	13.5	6.1	22.0	10.0	30.5	13.8
5.5	2.5	14.0	6.3	22.5	10.1	31.0	14.0
6.0	2.8	14.5	6.6	23.0	10.3	31.5	14.2
6.5	3.0	15.0	6.8	23.5	10.6	32.0	14.4
7.0	3.1	15.5	7.0	24.0	10.9	32.5	14.7
7.5	3.3	16.0	7.2	24.5	11.1	33.0	14.9
8.0	3.6	16.5	7.5	25.0	11.2	33.5	15.1
8.5	3.9	17.0	7.8	25.5	11.5	34.0	15.3
9.0	4.1	17.5	7.9	26.0	11.8	34.5	15.6

Solution Assays

For the determination of gold and silver take five assay tons of the solution in a beaker. Add 60 grams of test lead, put on the hot plate, and bring to boiling. Filter and transfer the lead filter paper and all to a scorifier. Add 2 grams of borax glass and reduce to the proper size button for cupellation.

For the determination of copper and lead take a 10-c.c. pipette of the solution, or more if very low-grade. Add about 10 c.c. of sulphuric acid and evaporate to white fumes. Then proceed as with the standard assay.

On account of the complex character of the commercial acid chloride solutions, the usual indicators are of no value. The cupro-ammonium sulphate method has been found best for this determination.

Dissolve copper sulphate in distilled water and dilute to one liter. Add ammonia until the heavy precipitate of copper hydroxide has almost, but not entirely, disappeared. Filter and titrate against a standard solution of acid.

Sometimes the freshly precipitated cupro-ammonium

sulphate will become cloudy, owing to a little copper hydrate which has passed through the filter. A second filtration will give a clear solution. Or, if the solution is allowed to stand overnight before filtering, this trouble will be avoided.

A good strength for mill solutions commonly used is 12 grams of copper sulphate per liter. With 10 c.c. of the solution sample, each cubic centimeter will equal approximately 2.5 lb. of sulphuric acid per ton. For stronger acid solutions, this strength can be increased, although the weaker the cupro-ammonium sulphate, the more delicate the end point. This end point is the first slight precipitate or turbidity in the solution.

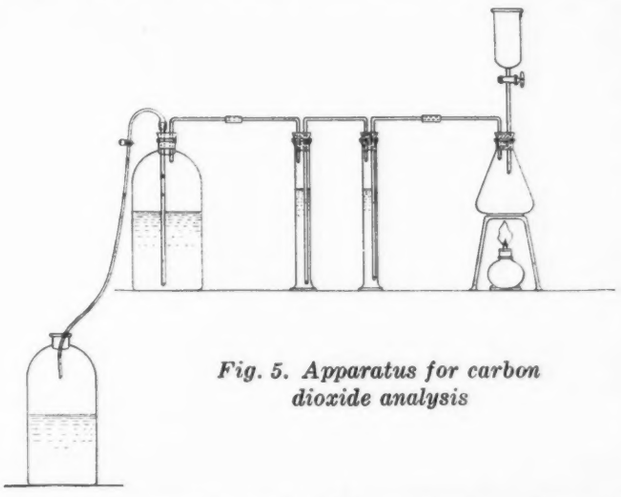


Fig. 5. Apparatus for carbon dioxide analysis

This determination is better understood by reference to Fig. 5.

Dissolve 20 grams of barium hydroxide in 1 liter of water, shake well, and allow to stand for three days. Make up a one-tenth normal hydrochloric acid solution and obtain its exact strength by titrating against either a standard sodium hydroxide solution or silver nitrate. Weigh 1 gram of ore into an Erlenmeyer flask. Measure into the two tubes. Connect up the tubes to the aspirator bottles and to the flask. See that all connections are airtight. Now run into the flask from the thistle tube a solution of hydrochloric acid (one part acid to three parts water). It is well to add a little copper sulphate to the acid to precipitate any hydrogen sulphide which may be generated. Aspirate the gas through the train and heat the flask to boiling over the alcohol lamp until the gas has been driven into the tubes and only steam is formed. Disconnect the tubes, wash them out quickly and thoroughly into a beaker, add a little phenolphthalein indicator, and titrate with the standard hydrochloric acid to a colorless solution.

From the equations below, figure the percentage of carbon dioxide.

$$Ba(OH)_2 + 2\,HCl = BaCl_2 + 2\,H_2O.$$
$$Ba(OH)_2 + CO_2 = BaCO_3 + H_2O.$$
$$CO_2 + CaO = CaCO_3.$$

Production of Platinum and Allied Metals Declined in 1923

The quantity of crude platinum produced in the United States in 1923 was 609 troy ounces, of which Alaska produced 7 oz., California 578 oz., and Oregon 24 oz., according to a statement prepared from mine reports by James M. Hill, of the U. S. Geological Survey. This is a considerable decrease from the 1,008 oz. produced in 1922.

The platinum produced in Alaska was largely a by-product from gold mined in placers in the Chisna district, in the Copper River region. A little more than 53 per cent of the output in California was mined by dredges in Butte, Calaveras, Sacramento, Stanislaus, and Yuba counties, the greater part of the remainder was mined by dredges in Shasta County; and less than 1 per cent was mined from small placers on tributaries of Trinity River in Trinity County. The platinum produced in Oregon was practically all recovered by the beach miners in the vicinity of Bullards, Coos County, and Sixes, Josephine County.

The statistics show that refiners of platinum in the United States purchased in 1923 29 oz. of crude platinum from Alaska, 707 oz., from California, 63 oz. from Oregon, and 1 oz. from Washington, a total of 800 oz., as compared with 1,058 oz. purchased in 1922. They also purchased 54,741 oz. of crude platinum mined in foreign countries, of which 48,727 oz. was shipped from Colombia and 4,997 oz. from Russia.

New Platinum Metals Recovered by Refiners in the United States 1919-1923

(In Troy Ounces)

Year	Platinum	Palladium	Iridium	Osmiridium	Others	Total
1919.....	40,220	3,807	401	402	279	45,109
1920.....	36,015	4,309	418	409	393	41,544
1921.....	51,791	2,686	286	581	1,026	56,370
1922.....	54,142	1,943	210	1,301	122	57,718
1923.....	46,780	1,934	280	787	16	49,797

Platinum Metals Imported for Consumption in the United States, 1922 and 1923

Metal	1922 Troy Ounces	1922 Value	1923 Troy Ounces	1923 Value
Platinum or crude platinum and unmanufactured products, ingots, sheets and wire	94,939	$7,790,898	86,417	$8,923,037
Platinum, manufactured products, vases and retorts	(a) 45	(b) 11,464	103	4,769
Iridium	1,899	298,567	1,611	276,539
Osmiridium	2,165	242,637	1,174	150,074
Osmium	1,012	81,231	1,462	147,144
Palladium	9,754	537,684	14,578	857,071
Rhodium	111	16,227	805	86,569
Ruthenium	100	4,839	487	21,492
	110,025	$8,983,547	106,637	$10,466,695

(a) Incomplete. Includes 18 oz. in vases and retorts, valued at $2,813, and 27 oz. in other products not specified, valued at $1,916.
(b) Includes articles to the value of $6,735 (quantity not given) imported under duty in 1922 prior to Sept. 22.

Platinum Metals Consumed in the United States as Reported by Refiners, 1922 and 1923, by Industries

(In Troy Ounces)

Industry	Platinum	Iridium	Palladium	Others	Total	Percentage of Total
1922						
Chemical.....	8,834	172	458	271	9,735	5
Electrical.....	24,988	1,537	2,735	.....	29,260	16
Dental.....	11,651	83	5,535	.....	17,269	10
Jewelry.....	108,527	2,588	9,852	1,190	122,157	67
Miscellaneous....	2,838	1,064	636	.....	4,538	2
Totals.....	156,838	5,444	19,216	1,461	182,959	100
1923						
Chemical.....	8,637	190	485	266	9,578	5
Electrical.....	18,596	1,675	3,666	.....	23,937	13
Dental.....	16,288	153	10,116	.....	26,557	14
Jewelry.....	105,699	3,073	14,948	190	123,910	65
Miscellaneous....	3,156	1,403	986	1,256	6,801	3
Totals.....	152,376	6,494	30,201	1,712	190,783	100

Stocks of Platinum Metals in Hands of Refiners in the United States, Dec. 31, 1919-1923

(In Troy Ounces)

Metal	1919	1920	1921	1922	1923
Platinum.....	29,228	46,747	38,514	41,900	36,554
Iridium.....	3,359	4,196	4,991	7,559	5,208
Palladium.....	10,235	16,565	21,042	24,975	26,266
Others.....	610	216	3,113	1,583	2,697

Marketing of Gold

Governments Play a Most Important Part in the Selling of the Metal

By Felix Edgar Wormser
Assistant Editor

Photo by A. Lease
Bullion balance weighing a Homestake bar

OF ALL the metals and minerals, gold is undoubtedly the easiest to sell. A market is always open to it, and, so far as the miner in the United States is concerned, the only procedure necessary is to take the gold bullion —pure or impure—to the nearest United States mint or assay office, where the metal will be assayed and settlement made on the basis of $20.67183 per ounce troy, 1,000 fine. Payment will be made by the Treasury Department either by a draft on the Treasurer of the United States, or in gold coin, refined gold bars, or in gold certificates—dollar for dollar, whichever is preferred. Silver in gold bullion is paid for at the current market price.

Occasionally a gold-mining company may prefer to ship its output to a near-by smelter rather than to the mint. I know of at least two instances of gold companies which produce a rather base bullion receiving quicker and also slightly higher returns by doing so, owing to payment from the smelter for the copper content of the bullion. When the gold ore or gold in non-ferrous metal ore is sold to smelters, payment is generally made on the basis of $20 per fine ounce for 90 to 95 per cent of the gold content of the ore.

The gold miner has one distinct advantage over his colleague working a base-metal deposit—he does not have to worry about a fluctuating *price* for his product. This does not mean that the gold miner can discard all care regarding the *value* of his bullion, for, as he has discovered to his regret in the last eight years, when the currency received in exchange for his production is translated into terms of purchasing power—that is, into the amount of labor and supplies he can buy with it—he finds that the exchange value of his bullion is not a steady quantity. Its fluctuation is slow, however, and the gold miner is seriously affected only by prolonged changes in the general price level. Commodity index numbers and variations in wage rates are the best guides he has for determining the general exchange value of his production. But the fact that fluctuations in price levels are slow and that this is his only source of worry gives the gold miner an advantage over the copper or lead producer, who must watch not only changing general price levels and their effect upon his cost of production, but also the often violent fluctuation in the price of the metal which he sells.

The gold miner also does not have to investigate the financial standing of his best customer—the United States Government—and the disposal of his bullion is a relatively simple matter. The Treasury Department maintains an assay office at New York (which makes large sales of gold bars to banks) and at Helena, Mont.; Deadwood, S. D.; Salt Lake City, Utah, and Seattle, Wash. One at Boise, Idaho, has been closed. At New Orleans, La., and Carson City, Nev., the department has mints which are conducted as assay offices. All the institutions mentioned are bullion-purchasing offices for the larger institutions in Philadelphia, San Francisco, and Denver, where coining operations are centered.

The assay offices also assay gold and silver ores for prospectors and any others interested. Electrolytic refineries are operated at the New York, Denver, and San Francisco plants. Although it would seem desirable for a mining company to consign its bullion to the nearest assay office, this practice is not consistently followed. A large gold-mining company in the West expresses its gold bars to the New York Assay Office, despite the proximity of, and much lower express rate to, a near-by government assay office.

The United States Government has certain charges and regulations covering the deposit of bullion in its assay offices or mints which are given in detail in an accompanying list. Bullion containing 800 thousandths or more of base metals is rejected by the mint. It can, however, be sold to the smelters who accept bullion regardless of its gold content. All bullion deposited carries a melting charge. Parting, refining, alloy, and bar charges as shown in the accompanying list refer to those shipments to the mint which will be withdrawn from it in the form of refined gold bars. These charges are of more concern to banks than to mining companies, as the mining companies ordinarily do not care what disposition is made of the bullion after it leaves them.

Facilities of the United States Government for taking care of all varieties of gold shipments are excellent. The largest assay office is situated in New York and can handle shipments in gold of over $15,000,000 per day.

Bullion of the gold-mining companies is generally shipped by express or parcel post after being carefully sampled and marked. Each bar may be wrapped in stout canvas and is often then packed in a wooden box as additional protection. As in all shipments of bullion, particularly those from one country to another, the loss of interest during transit is an important consideration, every effort is made to ship the metal promptly and to receive payment as quickly as possible. The mint usually pays 90 per cent of the estimated value of unparted bullion upon deposit and the remaining 10 per cent, less melting and any other charges when the exact value of the shipment has been determined. When deposits of gold coin are made—the government will accept any gold coin but the Russian ruble—settlement may run as high as 98 per cent of the value

of the consignment. In that event the fineness of the gold coin is known from official records, so that the value of the coin per ounce, allowing for base metal content, can be computed. Say it amounts to $18.60 per oz. Then settlement will be made for 98 per cent by weight on that basis. The 2 per cent remaining is paid when the assaying operation is completed—perhaps in a month. The smaller sized shipments, up to $20,000, are treated within a short time of receipt, often the same day as received, so that settlement is quickly concluded. Shipments running into the millions take longer to handle, especially coin, which is much more troublesome to weigh, so that complete balancing of payment is delayed.

Foreign Practice Modified by the War

Details set forth in the preceding paragraphs apply only to American gold producers, whose method of selling gold did not change during the war and has not changed since. Gold-mining companies in foreign countries have a peculiar status which has greatly modified their selling practice. This change has been brought about by embargoes established in nearly every gold-producing country, prohibiting ordinary movements of gold. The great gold-producing centers in South Africa, Canada, and Australia are subject to the restrictions of these gold embargoes, with one important exception—the embargoes do not apply to *newly mined gold*. Gold-mining companies in these countries may export their current production under license and sell it in the best market available. What this means to the South African producers, where most of the world's gold comes from, can be appreciated from an examination of the conditions under which the gold is sold.

In pre-war days of a "free" gold market in Great Britain, when gold could be promptly obtained and shipped to foreign countries without legal obstacles, an ounce of gold was worth 77s. 10½d. per standard oz. —916⅔ fine[1]—which is merely the British equivalent of $20.67+ per troy ounce, 1,000 fine. London was then the leading gold market of the world, owing to its financial pre-eminence, but now that the free movement of gold is prohibited in Great Britain supremacy has passed to New York, although it is noticeable that practically all the newly mined South African production still passes through London.

Great Britain has a free mint, or one that issues gold coins in return for fine gold received without any deduction for the cost of coining. The United States has, of course, a free mint also. In London one may tender bullion to the Royal Mint and have it coined into sovereigns. As this operation is not performed quickly, time may be saved by selling the bullion to the Bank of England, which will purchase fine gold at a minimum of 77s. 9d. per standard ounce (916⅔ fine) or 1½d. less than the 77s. 10½d. per standard ounce paid by the Royal Mint. The difference is the charge of the bank for the service it performs.

Up to July, 1919, the South African gold producer was required under contract with the Bank of England to market his bullion through London at the fixed price, less charges, of 77s. 10½d. per standard ounce. Rising costs of mining and milling (partly owing to the depreciation of the pound sterling) forced many mines on the Rand to close and caused pressure to be exerted by the mining companies on the British Government for relief. In July, 1919, an agreement was made between the South African producers, the Imperial Government, and the Union Government, whereby the gold-mining companies were permitted to ship their output to England, consigned to the Bank of England, to be sold in London to the highest bidder for home or foreign consumption anywhere. Ordinary embargo rules were not to affect South Africa's current production. This arrangement enabled the South African producer to obtain the same price for his bullion that the American gold miner receives, allowing for transportation, exchange and marketing costs. Formerly the Rand mines had been paid only the old price of 77s. 10½d. per standard ounce, which applied when England was on the gold standard. In August, 1923, arrangements were made for direct shipments of gold from South Africa to any destination, but still through the intermediary of London. The bulk of the South African output is shipped to London, however; a relatively small part to India.

London Gold Price Depends on Sterling-Dollar Exchange

Gold produced by the Transvaal mines is sent to the recently erected Rand refinery at Germiston, in the Transvaal, one of the largest refineries in the world, and is brought up from a fineness of 825 and 920 to a fineness of 995.5 for shipment abroad. On arrival at the Bank of England, South African newly mined gold is refined if necessary and then sold by the producers' agents, the Messrs. Rothschild. The Bank of England has authority to issue licenses for the exportation of this gold within five weeks from date of arrival at the bank, but as the amount of each shipment is cabled to London from South Africa a total time of eight to nine weeks is available for selling the metal. All charges for freight, insurance, refining, and assaying are borne by the producers.

The price paid for the gold in the market depends directly upon the depreciation of the pound sterling as measured in United States dollars and cents. The greater the depreciation the greater the amount of money—in paper—received by the South African producer. Inasmuch as the United States is the best market in which to sell gold, most of the South African metal has been coming to the United States via London, although some of it has been shipped to India, which is normally a great gold market.

What the African producer really does is to sell his metal for United States dollars, receiving the standard price of $20.67+ less charges. He converts the dollars and cents obtained into pounds sterling at the rate prevailing when the sale is made. Obviously, the South African producer thus procures a premium over the established price of 77s. 10½d. At times the price has gone as high as 127s. (February, 1920), but with improvement in sterling exchange the market price has declined and is now close to 95s.

The South African gold producer has had at times one advantage over fellow producers in the United States under this arrangement. He has been able to purchase his supplies and labor with depreciated British currency while receiving the full gold value of his bullion production in the open market. This advantage is most pronounced for a currency that is rapidly depreciating, but, at best, it is only of temporary duration.

[1]The London standard for gold, 916⅔ fine, should not be confused with the London standard for silver, which is 925 fine.

In the long run values of commodities tend to equalize each other all over the world and the advantage disappears. There is no question, however, that the gold premium has been a highly important factor in stimulating gold mining in South Africa at a time when it sorely needed this stimulus. Premiums have been reflected in the operations of Canadian and Australian gold-mining companies as well as South African ones. The last annual report of the Hollinger Consolidated Gold Mining Co., in Canada, shows a profit or premium of $175,000 on exchange.

Australian gold-mining companies are members of the Gold Producers' Association, Ltd., which was formed early in 1919 to market the newly mined production of the Australian Commonwealth at the best price obtainable.

The production of gold in India is generally used locally and is augmented by importations. Gold-mining companies in India have an arrangement with the Indian Government whereby they are paid for their metal on the basis of the London price in shillings converted into rupees, less charges. Consquently they, too, realize a premium on their output.

The Flow of Gold

Large amounts of gold are shuttled back and forth ordinarily from one country to another. Of late years most of the world's gold has gravitated to the United States, bringing the reserves in this country to extraordinary heights ($4,000,000,000). The total stock of gold in the United States has grown from $1,900,000,000 before the war (1913) to $4,338,000,000 on March 1, 1924, as a consequence of the heavy shipments made to the United States since the war.

The shipment of gold in international trade is a highly specialized business, in which a few large American banks are the leading factors. Before the war much of the shipment of gold to and fro could have been avoided had some international clearing house been established where gold credits might be instantly transfered from one country to another. The Federal Reserve Board in Washington uses such a system today for domestic purposes. Through a gold settlement fund it transfers gold credits from one Federal Reserve Bank to another without making actual gold shipments. Although a flood tide is carrying huge amounts of gold to the vaults of the Treasury today, sooner or later an ebb will occur, but just how it will be brought about and what its result on the prosperity of the country will be, authorities do not agree. Nearly all shipments of gold, owing to the concentrated value of the metal, are carefully insured against loss and theft. Shipments by registered mail are common.

Gold in Circulation in the United States

Perhaps the reader may have noticed the great number of gold certificates now in circulation in the United States. Look at the next ten- or twenty-dollar bill you receive to see if it is a Federal Reserve note or a gold certificate. Since the middle of 1922 the demand for additional currency in the United States has been met by the issue of gold certificates instead of Federal Reserve notes. In other words, gold has been put in circulation, the gold certificate merely signifying that so many gold dollars have been deposited in the United States Treasury vaults, to which the bearer of the gold certificate is entitled. There is so much gold in the country that the machinery of the Federal Reserve system has not been needed to aid the banks. This affects the earning power of the Federal Reserve banks, but proves that the country is in the position of someone with so much credit that it is not all needed.

The following table taken from the statistics of the Federal Reserve Board shows the change in the relation of the types of currency in circulation in the last two years:

	Aug. 1, 1922	March 1, 1924
Gold and gold certificates	$588,000,000	$1,049,000,000
Federal Reserve Notes	2,115,000,000	2,031,000,000
Other currency	1,634,000,000	1,728,000,000

Large amounts of gold are used each year in the industrial arts. The United States Assay Office in New York and the mint at Philadelphia are the principal sources of gold for the manufacturers, and it is there that they withdraw bullion for manufacturing, the most popular-sized bar being from $200 to $500 in value. Statistics completed by the Director of the Mint show the consumption of new gold in the arts to average about $35,000,000 for the last ten years, ranging from a minimum of $23,000,000 in 1921 to a maximum of approximately $54,000,000 consumed by the arts in 1919.

Gold Production of Principal Countries (*a*)

In Troy Ounces

	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923
United States	4,299,780	4,572,976	4,887,600	4,479,050	4,051,440	3,320,780	2,918,625	2,476,165	2,422,000	2,363,075	2,568,950
Canada	802,973	773,175	918,056	930,490	738,830	699,680	766,760	766,913	926,330	1,263,400	1,219,000
South Africa	8,798,710	8,395,964	9,096,100	9,296,848	9,018,385	8,418,375	8,331,651	8,158,455	8,128,700	7,009,860	9,133,100
Australasia	2,569,311	2,301,152	2,369,800	1,958,017	1,664,010	1,490,550	1,301,880	1,095,780	903,290	991,660	860,000
World	22,145,300	21,697,400	22,593,800	21,976,400	20,611,000	18,556,900	17,630,000	16,300,000	15,974,800	15,459000	17,600,000

(*a*) Reports of the Director of the Mint.
(*b*) Estimated.

The following is a table of charges at the mints and assay offices of the United States as fixed by the Director of the Mint and approved by the Secretary of the Treasury:

United States Mint and Assay Offices Charges

1. Melting Charge:

On each deposit of bullion a melting charge of $1 shall be imposed for the first 1,000 ounces or fraction thereof, and 10 cents additional for each 100 ounces or fraction thereof in excess of 1,000 ounces, computed on the after-melting weight: *Provided*, That no melting charge shall be imposed on deposits consisting of uncurrent United States coin or stamped mint fine bars; or on silver bullion free from gold, of the fineness of 998 thousandths or over, when a satisfactory assay can be obtained without previous melting.

On deposits carrying nonmetallic material or separate particles of nonprecious metals, when the melting loss exceeds 25 per cent, an additional charge of $1 for each deposit shall be imposed when the deposit weighs 150 ounces or less. On such deposits weighing over 150 ounces the charge shall be in accordance with the extra expense of the melting operations.

2. Toughening Charge:

Deposits which fail to give concordant assays shall, at the discretion of the officer in charge, be subject to an additional charge equal to the cost of the Government for fuel, labor, and materials used in remelting and treatment by the deposit melter. Impure deposits which fail to give concordant assays on dip samples from the second melting shall be returned to the depositor and the expenses incurred in treatment collected.

3. WITHDRAWAL AND REJECTION OF DEPOSITS:

Deposits may be *withdrawn* by depositors at any time before payment is tendered for same, and thereafter at the option of the officer in charge of the mint or assay office, subject to payment in cash of such charges for melting, etc., as have been incurred up to the time of withdrawal. *Rejected* deposits (all those containing 800 thousandths or more of base metals must be rejected) are subject to payment in cash of such charges as have been incurred up to time of rejection.

4. PARTING AND REFINING CHARGE (rate per gross ounce or fraction):

CLASS A.—*Bullion containing gold and silver.*

Gold Content		Base Content	
Thousandths	Charge	Thousandths	Additional Charge
½ to 250	$0.01	Up to 50	$0.00
250½ to 500	.02	In excess of 50 to 150	.005
500½ to 949¾	.04	Above 150, for each 100 or fraction thereof (additional to the half cent base charge)	.01
950 to 991¼	.02		.....
992 to 1,000	.....	(No allowance for silver content)..	.....

CLASS B.—*Silver bullion free from gold.*

Silver content	Charge
600 thousandths or less	$0.04
600½ to 700 thousandths	.03
700½ to 850 thousandths	.02
850½ to 950 thousandths	.01
950½ to 997½ thousandths	.005
998 thousandths or over, if payment is demanded in bars of a higher fineness or if it is necessary to refine such bullion	.003

CLASS C.—*Miscellaneous.*

Upon gold bullion below 992 thousandths fine and silver bullion below 998 thousandths fine, having but one precious metal present and having base content which is suitable for coinage alloy, including foreign coin and domestic mutilated or uncurrent coin, a refining charge will be imposed only when payment is demanded in fine bars, viz.:

Silver deposited for fine silver bars	$0.005
Gold deposited for fine gold bars	.01

When bullion contains less than one-fourth thousandths of gold and less than 8 thousands of silver the gold or silver content shall not be reported for the benefit of the depositor.

Gold coin containing 8 thousandths or over of silver acquires the status of bullion and is subject to appropriate charge for refining.

5. ALLOY CHARGE.

Two and one-half cents per ounce for the copper required for alloy, to be determined by taking one-tenth of the fine weight of gold, except when the base in the deposit is suitable for alloy purposes and the fineness above standard, in which case the alloy shall be determined by taking the amount of copper required to reduce the bullion to standard fineness.

6. BAR CHARGES.

Bar charges as below shall be imposed when bars are sold or when a depositor requests, directly or indirectly, special size bars in payment for a deposit.

Gold bars may be sold only when of standard fineness or above, for gold coin or gold certificates only, and in lots of not less than $5,000.

Silver bars may not be sold except upon special authorization.

GOLD-BAR CHARGES

	Per $100 Value
Bars of $5,000 in value and over	$0.05
Bars of less than $5,000 to $500, assorted sizes	.05
Bars of less than $500, assorted sizes	.07
Bars between $300 and $200, in lots of 20 bars	.09
Bars of a fineness of 999.9, not over $5,000	.09
Bars of a fineness of 999.9, over $5,000	.08

SILVER-BAR CHARGES

	Per Ounce Gross
Bars of standard silver	$0.00½
Bars of fine silver, not less than 500 ounces	.00¼
Bars of fine silver, between 125 ounces and 500 ounces	.00½
Bars of fine silver, 125 ounces or less	.00½
Bars of unparted bullion	.00½

7. ASSAYS OF BULLION AND PLATED WARE:

	Charge
Gold samples	$2.00
Silver samples	2.00
Plated ware, rolled or filled (may be refused)	4.00

8. ASSAYS OF ORES:

Assays of ores will be made at the minor assay offices and the mints at Philadelphia, Pa., New Orleans, La., and Carson, Nev., charges based on metals determined in sample:

Gold and silver	$1.00
Copper, tin, zinc, iron, lead and tungsten (each)	1.00

9. ASSAYING AND STAMPING CHARGES:

On bullion deposited for the purpose of receiving the Government assay and stamp, then to be returned to the depositor, shall be imposed the regular melting and regular special assay charges.

The gold production of the world declined during the war, but is beginning to recover. It is noteworthy that the proportion of the world's gold produced by South Africa has been increasing while that of the United States has declined. Of recent years serious attempts have been made to discredit the gold standard, some authorities urging its abolition entirely. It is extremely unlikely that any such a movement will succeed, because the United States and the British Empire have so much at stake in the gold-mining industry.

Barren Pyrrhotite Separated from Copper-Nickel Ores by Selective Flotation

The Canadian Department of Mines has recently conducted many tests on the selective flotation of the low-grade nickeliferous pyrrhotite ores of Ontario, and has published a summary of the work in Bulletin No. 15, Memorandum Series. The ore consists of the minerals chalcopyrite, pyrrhotite, and pentlandite, the last named being the nickel mineral, which is closely associated with the pyrrhotite in most of the orebodies. The tests were made to determine if it were possible to eliminate much of the barren pyrrhotite as well as the siliceous gangue, no attempt being made, according to the report, to separate the copper and nickel minerals. Further experiments were carried out to determine whether the precious metals, gold and the platinum group, were recoverable with the concentrate.

Given an ore of the following analysis—Cu, 1.25 per cent; Ni, 1.35; Fe, 23.70; S, 10.70; and SiO_2, 37.85 per cent—the recoveries of copper ran from 91.4 to 96.7 per cent; and of nickel, from 68.8 to 86.5 per cent. The grade of the concentrate varied from 7.40 to 16.50 per cent copper, and from 5.70 to 10.20 per cent nickel. Results are also given of a series of tests on an ore of still lower grade, containing 0.47 per cent copper and 1.17 per cent nickel.

"For the selective flotation of the ores," says the report, "the alphabetical reagents were found to be the most suitable," though nothing is said about which ones were used, or the amounts. "In using these reagents, the essential point is to carry an alkaline pulp, obtained by the addition of lime, soda ash, or caustic soda. The chalcopyrite floats with remarkable ease; the nickel minerals are more difficult to float."

In the tests for precious-metal recovery, a concentrate was made in which 95.5 per cent of the copper was recovered, 80.6 per cent of the nickel, 66.8 per cent of the gold, 70.3 per cent of the platinum, and 68.5 per cent of the palladium. Thus, though the gold and platinum metals are recovered to a large extent in the concentrate, it is evident that a substantial portion must be wasted along with the barren pyrrhotite or gangue.

An Expedition Into the Whitewater

Reconnaissance in a Little-known Area of British Columbia

By George H. Shepherd
Mining Engineer, Vancouver, B. C.

George H. Shepherd

THE Trites, Wood, and Wilson expedition into the Whitewater district of British Columbia was organized in July, 1923, under the direction of Byron Wilson, E.M., to whom I acted as assistant engineer, assayer, and mineralogist. A complete gasoline assay outfit, together with camp equipment, mining, and food supplies, was freighted into the Whitewater valley by pack train. The journey occupied five days, owing to heavy, unwieldy packs, and to serious cases of weed poisoning that developed among the pack animals, some of which died of this cause on the trail. Six miners were employed, and a permanent camp was established at the Province claim, adjoining the Windfall mine. Operations in the Whitewater were concluded on Sept. 6, on which date the excellent trail over Warner Pass was completed.

The Whitewater district lies due north from the city of Vancouver a distance of 125 miles, and occupies terrain in both Clinton and Lillooet mining districts of British Columbia. The locality may be approached either from Shalalth station, on the shores of beautiful Seton Lake, or from Williams Lake station, both on the Pacific Great Eastern R.R., whose railhead at Squamish is 40 miles by steamer from Vancouver. Shalalth is 90 miles north from Squamish, Williams Lake lying 130 miles farther to the north of Shalalth. Entering via Shalalth, heavy auto-truck service may be utilized from the railroad to Tyaughton (pronounced Tyaxon), 35 miles to the northwest, at which point pack animals, their equipment, and the services of experienced packers may be hired.

Accommodations at both Shalalth and Tyaughton are good, and the scenic beauties of this favored section are worth separate mention. From Tyaughton, the auto road stretches about 20 miles further to the southwest, terminating at the Pioneer mine camp, on Cadwallader Creek, and passing en route the Haylemore and Fergusson placers and the Arizona, 40 Thieves, Lorne, Blackbird, Ida May, and Coronation lode mines, several of which possess enviable records of gold-bullion production in the recent past.

Supplies for the Whitewater are loaded upon units of the pack train at Tyaughton, and the road is traversed a further 5 miles to a point where the Gun Creek trail-head is reached. From this point forward, the trail climbs at a fairly easy gradient, for 25 miles, till Trigger Lake is reached, touching the camping sites at Eldorado Creek, Spruce Lake Forks, and Humming Bird Lake.

At Eldorado Creek camp site, a branch trail about 5 miles long leads up into the Eldorado and Taylor basins, where some interesting ledges of auriferous arsenical pyrites outcrop. The floor of the Eldorado Basin covers considerable virgin placer ground, which, it is claimed, will average 25c. in gold per cu.yd. At Trigger (Green) Lake, the trail forks, and one may enter the Whitewater valley either by crossing the Taylor Pass (6,954 ft.), to the south, or by climbing the much shorter and steeper trail to the Warner Pass (7,800 ft.), the saddle-divide of which is overlain with permanent glacial ice. Though steeper, the Warner Pass trail, completed in September, 1923, robs the ascent of much of its difficulty and is far less swampy than is the longer route; it is better to cross either pass before the sun attains height, as morass and glacier are far easier to traverse while a frozen condition as to surface obtains.

The passes are open to traffic from the first of July till the end of October, snow closing both routes for the rest of the year.

The Whitewater Valley

The Whitewater River valley stretches northwest from the Taylor Pass to the lakes, a distance of 20 miles, and is fed by numerous milk-tinted torrents which have their sources high up in the many glaciers that crown the higher rims of the cirque basins and hanging valleys common to the region. The valley, as viewed from the Warner Pass, affords an arresting sight: to the northeast, the castellated pinnacles of Battlement Ridge rear their picturesque fangs against

Pack train on Warner Pass glacier, summit 7,800 ft.

the blue, and are rendered still more outstanding by the series of light yellow dikes or sills, a gigantic specimen of which dips at a flat angle from the ridge summit, easterly, across the mass of the Battlement Ridge. These dikes are classified as quartz-diorite porphyrite.

Abundant ferruginous staining is apparent, on either slope of the valley walls, the color scheme varying from light yellow to reddish brown, bespeaking the presence of excessive quantities of pyrites of iron in the tinted formations.

The elevation at Taseko lakes level is approximately 4,400 ft., and the maximum heights attained by the

Battlement Ridge

ranges to the north and south of the valley are 9,000 and 8,500 ft. respectively.

Denain, Rae, FeO and Battlement creeks flow down to the main stream, from the north slope between the Warner Pass and Windfall westerly side line, and it is in the higher contours bisected by these small streams that surficial deposits of brown limonite of an estimated tonnage of 63,000 are situated. Further deposits of this ore, in adjacent territory, bring the total estimated tonnage up to nearly one million tons.

Geology Briefly Described

The north wall of the Whitewater valley lies in the region covered by the Taseko formation, and consists of basaltic flows, tuffs, and igneous sills of porphyry, accredited to the Tertiary age, being considered the youngest of the igneous series of the district. The south wall consists mainly of massive quartz-diorites, of late Jurassic age, and is grouped with the Bendor batholith.

In contact with both Taseko and Bendor batholith, and occupying the length of the Whitewater River valley, between these formations, lies the much altered mass of older basaltic tuffs and lava flows and agglomerates, grouped under the name of the Denain formation, considered the most ancient of the local geological features. It is in the Denain formation, near to the contact between Denain and Taseko formations, one-half mile up Battlement Creek from its juncture with the main stream, that the original gold strike of the district is located—the property named the "Windfall mine" by the pioneer Taylor, and operating at present under the name of Whitewater Goldfields.

The Windfall Mine

Wash gravel covers this area to a depth of several feet, below which an occasional glacial drift boulder may be unearthed. High-grade ore fills two narrow veins and cross-fractures, occurring in the form of soft, yellow, and bluish-yellow talcose gouge, within which substance may be found imprisoned angular fragments of wall matter, and of dike substance, barren of values; and a dark-green, honeycombed, hornblendic, leached-looking substance, assaying usually around 10 oz. of gold per ton. The talcose ore assays around 100 oz. per ton. The veins are generally a little under one foot in width. Extremely rich pannings may be got from sections of the gravel wash, and it is disconcerting to obtain an ounce or more of coarse gold from a twenty-pound panful of gravel, picked from beneath the roots of standing trees, at the gulch rim.

I was informed by assayer Stratford, last January, that three such pansful had yielded 25 oz. of coarse gold.

The Windfall mine is located upon a so-called "dike," an altered basaltic intrusion, that foothills the north side of the Whitewater valley, a distance of 15 miles. This dike is quite an institution among Whitewater's prospecting fraternity; albeit it becomes the rock upon which many a sturdy (if vain) hope has been shattered, it still retains an unshakable hold upon the affections of the dauntless "knights of the pick."

Considerable tunneling and drifting has been accomplished on both the Windfall and adjoining Province claim (east of Windfall), but little of interest had been exposed at any point during my sojourn there.

Gold from the Windfall property is of three distinct varieties: large "colors," bright, and spongy. The genesis of the yellow metal remains a matter of conjecture, the more so as individuals well qualified to give an intelligent opinion have been refused the courtesy of an untrammeled inspection. It is to be hoped that the management will remove this unwelcome restriction, this opening season, at least in so far as engineers are concerned. I am inclined to the theory that a stockwork of small, extremely rich veins has been eroded by retreating glacial agency.

Cleavage planes within the dike matter are coated, often to a thickness of one inch or more, with a deposit of pale-blue, translucent steatite; and pyrites of iron occur in like manner, though perhaps in greater quantity. Within the Province tunnel, spherical crystals of pyrites of iron, often larger in size than a marble, were mined in considerable quantity, the crystals freed with ease from the groundmass, leaving a cast of their shape impressed upon the dike substance. Isolated cubes of galena were found also, embedded within the steatite and assaying up to 8 oz. in silver but barren of gold.

A Ross mill was set up at creek level, upon the Windfall property, last season, serving as a cleanup pan for the recovery of free gold from high-grade wash material, the creek water supplying the motive power.

The Mother Lode

To my knowledge no property other than the Windfall situated along the course of the dike proved of interest during my residence in the Whitewater, despite the fact that hereabouts staking and prospecting have assumed a somewhat feverish aspect. The reverse is true, however, of properties staked across the valley southwest from the Windfall, along the line of the great eastern contact between the batholith and the Denain

Windfall mine camp

formation, which latter formation the batholith is considered to intrude: a property of perhaps outstanding interest being that known as the Mother Lode group. The group covers the major portion of Mother Lode mountain that extends above timber line, the elevation of the mountain being approximately 8,000 ft.

The appearance of the batholith on Mother Lode mountain is that of an even-grained, gray quartz-diorite. The Mother Lode ore zone bisects this formation for a distance of 6,000 ft., striking, generally, east and west across the mountain and having its apex about 100 ft. below the summit on the north slope. The dip of the lode is southerly. The deposit is of major dimensions, measuring 60 ft. in width at the apex of the ledge, and widening to 300 ft. in width at its westerly extension, at which point a series of aplitic dikes, evidently of more recent origin than the ledge, bisect the lode at right angles to its strike, but without noticeable surface displacement of the orebody.

About the north slope, below the apex of the deposit, lie scattered a number of huge, angular masses of vein matter, sheared from off the ledge above, and conveyed and deposited, without injury, in their present position, doubtless by glacial agency. Small float is abundant upon the upper slopes of the mountain, and surface pannings yield, in places, besides coarse gold, solid chunks of azurite and malachite, galena and lead carbonate, the metalliferous constituents of the lode matter in place. Developments upon this property consist of a trench 6 ft. wide and 35 ft. long, excavated at right angles to the strike of the deposit, at a point northwest from the summit; a second trench, of like dimensions, and heading into the first trench, has been dug in a direction parallel with the strike of the deposit.

Samples taken at intervals across both cuts, by the locators, and assayed at the Government Assay Office, at Victoria, British Columbia, yielded returns as follows:

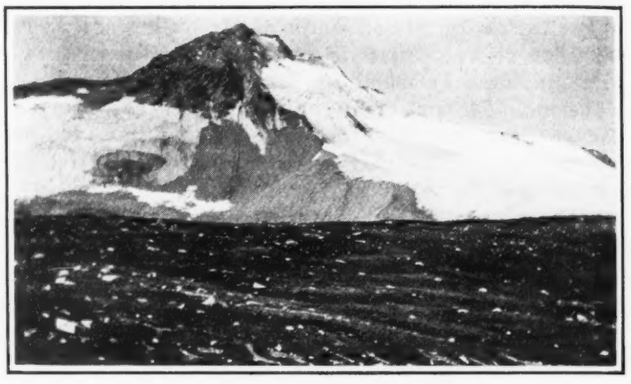
No.	Gold, Ounces	Silver, Ounces
1	Trace	0.6
2	0.96	0.6
3	15.12	5.0
4	0.10	0.4
5	8.40	2.0
6	Trace	0.4
7	0.36	17.0
8	Trace	Trace
9	3.4	10.0
10	2.2	10.0

All samples exhibiting free gold were refused assay, their commercial worth being apparent, and economy in the use of assay supplies being of first importance. The Mother Lode ledge matter consists of a true quartz-conglomerate, in which translucent crystals of quartz occur, up to one inch or more in length, the cementing matrix being largely kaolin, calcite, limonite, and feldspar. Gold, coarse, solid, and somewhat base, containing, besides silver, more than a trace of iron and lead, is frequently to be seen in specimens from differing sections of the lode: the gold would equal about $14 per ounce. Oxidation does not extend to great depth. The surface width, length and persistence of the ore zone, however, should insure a vertical depth commensurate with its exposed surficial dimensions.

Conclusions

No new district discovered in the West within recent years probably has suffered so at the hands of the purely speculative claim staker and wildcatter as the Whitewater. Scores of claims have been staked within the Whitewater valley by these parasites, who charge the city greenhorn $100 for each claim so staked, and further sums for mythical exploration work and assessments. To such an extent has this disastrous condition obtained that practical and well-qualified prospectors, arriving within the Whitewater, equipped at great expense, have found the country staked for a distance of nearly 40 miles along the course of the river. It is satisfying to consider that the major part of this wildcat area will be open to legitimate prospecting this summer, and that the speculative element will find it increasingly difficult to operate.

It would be discourteous to conclude a description of the Whitewater without mention of the presence of the trading, nomadic Chilcotin, from whom a fairly serviceable saddle or pack animal may be secured for



A glacier near Taylor Pass

$10 or $20 in cash; checks he will have none of—so far has civilization carried its keen-edged lesson to his primitive understanding.

Foremost among the ranks of the big game of the Whitewater country is placed the name of the "bull-dog" fly. Arriving with and departing with the daily summer sunshine, this huge insect, of the general appearance of a horsefly, albeit nearly twice its size, will provide entertainment and exact concise attention at all times, and at no time with more complete success than when the unfortunate assayer, working roofless under the summer sky, stands poised, ready to pour a hard-won melt. At such a moment, Shylock, craving his "pound of flesh," finds parallel in this his (possible) prototype; and none the less so if, in securing his pound of flesh, the bull-dog, outreaching the Hebrew, secures more than "One drop of Christian blood."

Phosphate Rock Mined and Shipped in 1923

Preliminary figures compiled by the U. S. Geological Survey show that 2,998,500 long tons of phosphate rock, valued at $11,396,900, was shipped from mines in the United States in 1923. Florida, the leading state, shipped 2,555,400 tons, worth $8,984,800, more than nine-tenths of which was land-pebble phosphate. Shipments from Tennessee and small amounts from Kentucky were 437,900 tons, worth $2,387,100. Idaho and Wyoming made small shipments.

The phosphate rock mined in the United States in 1923 amounted to 2,857,700 long tons, which is 22 per cent more than that mined in 1922. More than four-fifths of it was mined in Florida. Most of the remainder was mined in Tennessee and Kentucky, though a small quantity came from Idaho and Wyoming.

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Financing the Prospect

Co-operation of Banks and Bankers Essential to Education of the Public in Making Discriminating Mining Investments

THE EDITOR:

Sir—After reading the various articles recently published on the subject of financing the small mining companies and prospects, it seems to me that at least one phase of the question has not yet been touched. During the last few years, I have been confronted time and again with the very problems under discussion. Having a consulting mining engineering business in the heart of a territory liberally sprinkled with small mines and undeveloped or partly developed prospects, I have naturally come into much closer contact with the struggling owners than would have been the case had I been located in one of the larger cities. I have watched repeated efforts to finance these enterprises fail miserably, and I have concluded that there are several reasons for these failures. Different classes are responsible in different cases, but no one class or type of individual can fairly be blamed to the exclusion of all others.

First, the small prospector is largely dependent on a grubstake and has to rely on men not directly concerned with mining. These men recognize the speculative nature of the business and want to furnish only enough money to keep the prospector going until they can sell out at a handsome profit. In return for the "stake" they usually get the lion's share in the property, and after investing for several years they either quit or attempt to form a "company." To do this, they must sell stock, and to that end they must have a report. There is no great discrimination in the matter of getting this report. It is well known that a mining engineer will be conservative, so, if possible, one is avoided. Very often a "report" is written by a "practical mining man," and in the first few pages the author is careful to set out his qualifications. In Montana he is usually a seasoned veteran on the Butte mines, and in most cases has actually seen the mines at some time in his career. I have encountered some of these "reports" that were absolutely unintelligible. But to the uninformed citizen a few long phrases resoundant with mining terms are conclusive that the author is really a mining expert.

The too frequent employment of "practical mining men" in the matter of writing reports is partially the fault of the mining engineering fraternity. Too often the young engineer feels that unless he finds a body of ore blocked out, that he can sample and value along the lines indicated in Mr. Fearing's article on "An Analytical Method of Summarizing Mining Reports," in your issue of Oct. 27 last, he must turn the prospect down, or give such a doubtful report that it is of no possible use to the owners. I do not mean to suggest that an engineer is justified in recommending a prospect on possibilities alone, nor that he should pass favorably on something that has a doubtful "showing"; but I do mean that he should be fair to the property and report what he finds and what he thinks. Of course such a report must state clearly just what are the risks and cannot be in any sense the kind of a report that the same engineer would write on a partly developed property having ore in sight that can be sampled and measured. When engineers are willing to be fair to the prospect, as a class they will be much better thought of and respected by the small miner and prospector.

To refer to one concrete example, already mentioned in Mr. Goodman's letter published in your issue of May 17: I wrote the first report on the Forest Rose mine, now owned by the Butte & Western Mining Co., in October, 1918. At that time not more than fifty tons of ore were in sight, and the prospect had been gophered badly, but after stating the risks involved and that my recommendation was based almost entirely on geological data, I recommended the property for further development. A year later, after considerable work had opened up some apparent oreshoots, but still no ore was strictly "blocked out," another engineer gave a flatly adverse report. The only reason I could glean from it was that no ore was in sight that could be measured, and therefore the property was no good. But the owners persisted and began to open up ore, and today have a good mine that has been favorably passed on by several conservative engineers. The point I want to make is this: had the second engineer written the first report, the mine would have been damned forever. Conservatism is a good thing, but it should not be carried too far, and when it is, both the small mine owner and the small investor lose confidence in the engineer and turn to sources of information that are unreliable. Loss and dissatisfaction result, and mining gets a black eye. And it is always the worthwhile propositions, conservatively presented, that suffer the most.

Second, the investing public rarely invests without getting advice in some form or other, and most of this advice comes, directly or indirectly, from bankers and brokers who advertise themselves as "financial advisers." The very safe and conservative investments yielding 4 or 5 per cent are rarely attractive to the person having only a few hundred dollars to invest. The returns mean too little and he wants something that will pay big. If he goes directly to a banker with a proposition to invest in a mining venture it is a safe bet that he will not invest, but will put his money into a loan handled through the bank. He knows this and

so gets his information through some indirect means, but the information is so often the same that it can be said to be invariably so. The banker condemns all mining investments as equivalent to throwing money away.

The result of this sweeping condemnation has its effect on the mind of the investor. If he is taking such a tremendously long shot, with one chance of winning in ten thousand played, then he will play for the biggest stakes in sight. The wildly improbable reports of many of the "practical mining men" read much better than the more conservative, businesslike reports of the engineers. Yet all are condemned alike by his "financial adviser," and, this being so, he of course takes the chance that promises the most—and gets unmercifully stung. I believe that if the bankers who advise their clients were to regard mining as a legitimate business and give advice along such lines, there would be much more discrimination by investors. The sources of information would be more closely examined and the chances of the project more carefully weighed.

This attitude toward mining on the part of bankers as a class seems to me to be merely a habit of mind. It is contagious and deep seated. The young man just entering a bank as teller or clerk feels a measure of importance and responsibility. Let the subject of mining be mentioned in his presence, and, whether he be in Maine, New York, or Montana, up go his hands in an expression of holy horror. In ninety-nine cases out of a hundred he knows nothing at all about mining, but he feels that his prestige as a man of finance requires him to run down the mining industry at every turn. In time this attitude, which is affected at first, grows to be natural, and he becomes a natural enemy of mining. I believe this is the rule, although of course there are exceptions.

The remedy for this lies in education. The banker must be educated. When he becomes receptive to mining propositions and is willing to investigate and judge them with the same fairness and candor that he uses in other matters, mining men will go to him and deal with him, to the great advantage of both parties. When that day comes, a legitimate, safe and worth-while mining development project, properly presented by reports written by competent engineers, can get at least respectable attention from the small investors of the nation. The owner of the prospect will have the same chance as the owner of the farm who wants to raise capital for needed improvements, or the small operator who wants to start a little flour mill or creamery and hasn't enough money. The different cases appear to me to be exactly parallel, allowing a little increased rate of interest in the case of the miner, because of the increased risk. But they would all be on the same general footing.

To attempt to educate the general public in the matter of making wise mining investments would be an altogether unwieldy, if not impossible, undertaking. But to educate their financial advisers and through them reach the public seems a reasonable possibility. It would be worth trying.

There is something of a parallel in the position of the mining engineers in many cases and the bankers. Engineers too often knock their own game by ultra-conservatism, induced by their fear that they may recommend a failure. Bankers knock mining consistently, owing to their fear that they may recommend a failure. The result is that the small operators go to incompetent and often unethical parties to write the reports on which they rely for financing their properties, not caring to risk an unfairly negative report by an overly fearful engineer. Then they go to unscrupulous money sharks to raise the money, because the reliable banks take an attitude consistently unfair to their industry. The investor has no place with which he is personally familiar to which he can go and be sure of getting correct and impartial advice in the matter. The result is disastrous to the investor and mine owner alike, but fine for the broker shark. Incidentally, both the mining engineer and the banker are bound to lose.

If the mine owners, engineers, and bankers would all get together and deal on a basis of general fairness, each recognizing that the others have something worth while, I believe the present impasse in the financing of good prospects would be greatly relieved.

Deer Lodge, Mont. GEORGE S. KEARNEY.

Their Lair Disclosed

THE EDITOR:

Sir—According to an editorial comment in a recent issue of *Engineering and Mining Journal-Press*, certain persons crave to know where all the good prospects are hiding. It gives me much pleasure to enlighten these anxious inquirers as to where a majority of the North American mines of the future exist. The precise boundaries of the tract containing them are as follows: Bounded on the east by the Atlantic Ocean, on the south by the C.P.R., on the west by the vast Pacific, while to the north its limits have not been fully recognized. Much of this enormous territory has never been trodden by the foot of a white man, and even where penetrated it has been by either the fur trader or the lumber cruiser. Now, it happens that the trapper is merely interested in tracks, while the lumberjack keeps his weather eye lifting for timber trees and cares not at all for the rock beneath his feet. As for the Indian, he is the most hopeless case of all, and it is positively incomprehensible how an otherwise shrewd, observant man can be such an utter failure as a prospector.

Much of this great empty land is, as most of those interested in mining know, covered by the great pre-Cambrian shield, one of the most attractive prospecting fields in the world. Here there are no fevers, no dangerous wild beasts, no deserts; on the contrary, in the clear, pure air of the northern wilderness even the homely bean and the lardaceous pig's eye go very well with most stomachs. Moreover, the Canadian law permits just the same privileges to the uitlander as to the native.

It is some years since I left college, but unless my memory is playing me a trick the population of the United States at the time of the last unpleasantness with King George's men was just about one and a half times as large as is the Canadian population of today. And if the prospector, knowing what he now knows, could be transported back to the original thirteen states, wouldn't he have a snap?

It may be asked, and with reason: if this great Canadian wilderness is so alluring and so empty why do not more men devote their lives to searching it for fortune? That's just what beats me.

Victoria, B. C. CHARLES A. BRAMBLE.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

BY UNANIMOUS VOTE the United States Senate has approved the measure introduced by Senator Pittman directing the Treasury Department to purchase 14,589,730 oz. of silver at $1 per ounce. This is the sequel of the Senator's long dispute with the Treasury Department.

The Quincy Mining Co. in Michigan will soon increase copper output from Nos. 2 and 6 shafts to full capacity. Lower costs will result.

The Chief Consolidated Mining Co. expects to have its new reduction plant at Eureka, Utah, in operation within two months.

Mines in the Coeur d'Alene district, in Idaho, netted $5,165,262 during 1923 from ore with a metal content worth $21,557,673.

Rouyn Township, in northern Quebec, is the goal of many gold seekers from Ontario.

After a shutdown of two years, the Consolidated Mining & Smelting Co. has resumed operation of its copper smelter at Trail, B. C.

Fire destroyed the hoisting plant, mill, and flotation plant of the Coniagas Mines Co., at Cobalt, Ont., on May 30. The plant will not be reconstructed.

Some mystery seems to surround the sudden increase in London of shares in the Globe & Phoenix company of Rhodesia.

Four important gold-mining companies operating on the Mother Lode in California are deepening shafts.

Sinking of its shaft to 1,800 ft. is planned by the Calumet & Arizona Mining Co. at its 85 Mine, near Lordsburg, N. M.

Senator Ferris, of Michigan, Democrat and a free-trader by principle, will advocate the proposed tariff on copper.

Four Mother Lode Mines Are Deepening Shafts

Big California Gold Mining Companies Busy — Co-operative Geological Survey Planned for Summer

A significant activity along the Mother Lode region in California is the resumption of shaft sinking at various mines. At the Plymouth the shaft is being deepened at the rate of 100 ft. or more per month. Milling has been reduced to 100 tons per day (twenty stamps) and will probably be maintained at this rate while shaft sinking is in progress.

At the Central Eureka, near Sutter Creek, the main working shaft is being sunk from the 4,250 level to the 4,400. Thirty-five stamps are being operated, and these will be increased to forty stamps as soon as the new level is opened.

The Kennedy mine is operating eighty stamps and will soon have 100 stamps in operation. At the Argonaut shaft, sinking was begun early in May. The main working shaft will be sunk from the 4,850 level to the 5,150. Sixty stamps are in operation, and about 7,000 tons per month is being milled. Both concentrates and tailing are successfully treated at the cyanide plant operated by Hamilton, Beauchamp, and Woodworth, who are also operating the concentrate and tailing plant of the Carson Hill Gold Mining Co. at Melones.

The Moore mine, south of Jackson, is sinking from the 800 to the 1,000 level. At Carson Hill, milling has been reduced to about 300 tons per day, the mill being operated on two shifts. Additional development work is in progress. At the Mammoth, near the Middle Bar bridge on the Mokelumne River, development and exploration are being extended from a 3,000-ft. tunnel. A small mill has been erected and is occasionally operated.

During the summer the U. S. Geological Survy, in co-operation with the California State Mining Bureau, will begin an investigation of mining conditions on the Mother Lode. The work will be done by Adolf Knopf, of Yale. Since the investigations by F. L. Ransome in 1900 little geological work has been done on the Mother Lode except by private parties. Development has now reached greater depths, although the number of active mines has diminished.

Keno Hill Ore Proved at Depth of 600 Ft.

Word has been received that the Treadwell Yukon Co. has struck the vein at its property at Keno Hill, Y. T., at a depth of 600 ft. This, it is assumed, settles the question which has been in debate as to the Mayo district being a "deep" mining camp. It is thought that the permanence of profitable mining in that section is now assured.

Fire Destroys Coniagas Mine Plant and Mill at Cobalt

Loss of $350,000 Covered by Insurance —Mine Neared Exhaustion, and Reconstruction Is Not Warranted

The entire plant of the Coniagas Mines, Ltd., at Cobalt, Ontario, was destroyed by fire on May 30. The flames started at the rear of the mill and spread with such rapidity that all of the company's buildings were consumed in about an hour. The structures destroyed included the shafthouse, the mill, the flotation-plant buildings, and the assay office. The loss is estimated at $350,000, fully covered by insurance. The town of Cobalt was for some time menaced by the blaze, owing to the strong wind which prevailed, and practically the whole population turned out to check the spread of the flames.

The fire definitely ends the activities of the Coniagas company on the pioneer property, the mine being within one year of exhaustion. The mill has been running recently on ore that has not yielded more than $5 in silver to the ton, so that the mine will not be reopened, nor the mill rebuilt; and about 100 men will be thrown out of employment. Output recently has been about 425 tons per day.

The company will retain its headquarters at Cobalt and devote its attention to the newer properties which it has acquired in late years.

Gold Seekers Head for Rouyn in Quebec

Noranda Report Shows 375,000 Tons of $20.27 Ore—Total Value $7,602,000—Copper Content Ranges from 5 to 15 per Cent—Nipissing, Hollinger, and Other Large Interests Represented

By Arthur B. Parsons
Assistant Editor

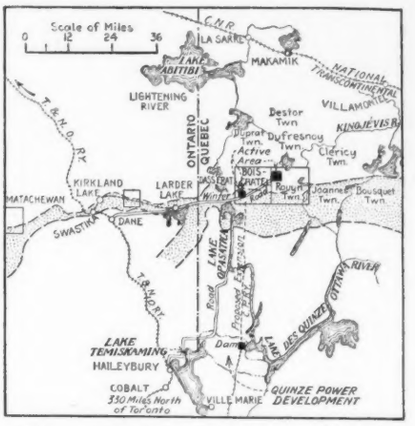
A PECULIARITY of the gold fever is that frequently it spreads, in deadly form, without any apparently adequate reason. Evidently this is not the case, however, in Rouyn Township, in northwestern Quebec, with which, it is safe to say, no other area in the world can compare today in the virulency of its affection with this peculiar malady. There appears to be ample cause for the epidemic. In the first place, Rouyn lies in the more southerly of the two main gold belts that traverse northeastern Ontario and extend into Quebec. As mapped by Canadian government geologists, who are both prompt and reliable in working out the regional geology, this wide belt passes through the Shining Tree, Matachewan, Kirkland Lake, Larder Lake, Lake Fortune and Rouyn areas and continues easterly. It follows in a general way the outcrop of the Temiskaming sediments. Gold has been found in many places; the problem of the prospector is to discover a locality where the precious metal is deposited generously enough to make it worth mining.

And, in the more weighty second place, Noranda Mines, Ltd., in its annual report for 1923, which includes an account of development done up to March 31, 1924, "conservatively estimates indicated ore" on its Horne group of claims as follows:

	Tonnage	Gross Value of Ore Copper at 13c. per Lb. Silver at 60c. per Oz. Per Ton	Total
Center deposit	225,000	$25.00	$5,625,000
West deposit	42,000	8.50	357,000
East deposit	108,000	15.00	1,620,000
Totals	375,000	$20.27	$7,602,000

If this value were all in gold the $7,602,000 would, of course, be more impressive. As a matter of fact the gold averages only about $5 per ton and the ore is sulphide in character, containing pyrite, pyrrhotite, and chalcopyrite. I understand, however, that higher assays have been obtained in work done since March 31. In addition, the Noranda company has on its near-by Chadbourne claims a remarkable showing of "straight" gold ore that assays from $4 to $15 in veins from 10 to 15 ft. wide; and on the Powell property, two miles northwesterly, the Nipissing interests, of Cobalt, are sinking an inclined shaft to explore a vein that is reported to assay $5 in gold near the surface.

Virtually all of the work on the Horne group has been done since September, 1923; and as it is the "big show" thus far, the present prospecting season, which is just getting under way, will no doubt witness a rush of activity. The immediate vicinity is already well covered with claims, but many of them are virtually unscratched and many hundreds of miners are expected to be at work trenching and sinking during the summer. Several well-financed interests, aside from those already mentioned, are already buying up options, and a rushing business in buying and selling claims is anticipated. The accompanying claim map is taken largely from the Noranda report.

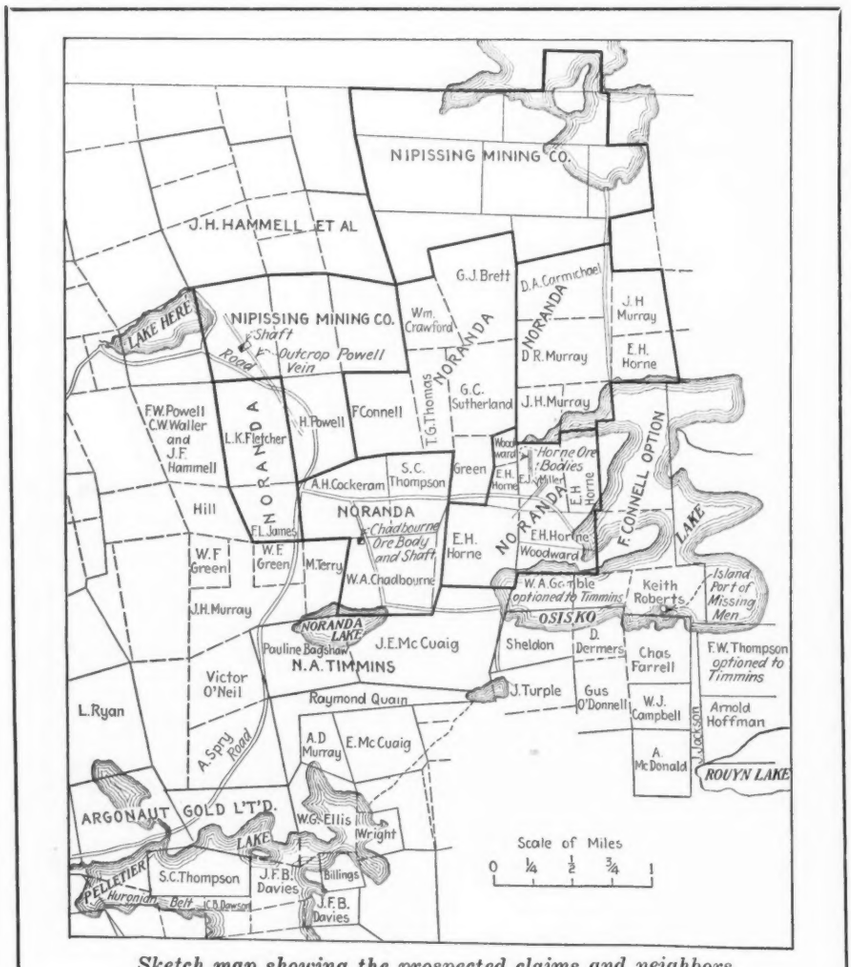


Map of the Rouyn district, showing the "gold belt"

J. C. Weir, of New York, went into Rouyn during the spring "break-up," and has just returned. To him I am indebted for the photographs that are reproduced here, and for sidelights on some of the people who have spent the winter in the district. Mr. Weir had a thrilling experience "mushing"—and swimming, thanks to the melting of the winter's accumulation of snow—from Dane, on the Temiskaming & Northern Ontario R.R., to Rouyn, by way of Larder Lake.

The outpost of the Rouyn area is at Lake Fortune, where Messrs. Alderson and McKay are systematically developing the Lake Fortune and Ironfield mines. Some unusually rich outcrops were discovered last summer, and the winter has been spent sinking a 125-ft. shaft. A first-class radio is one of the luxuries, or perhaps necessaries, of their equipment. East of the Lake Fortune, F. S. Arnfield has let a contract for diamond-drill exploration of a fair showing of gold over an area 1,200 ft. long by 30 ft. wide.

The first camp in Rouyn proper is that of the Nipissing company, at the Powell claim. Here W. Lee Heidenreich is the engineer in charge, assisted by Kenneth Carmichael. Aside from the general hospitality extended to him, Mr. Weir was impressed with the constant display of energy on the part of the staff, the members of which seemed



Sketch map showing the prospected claims and neighbors, after the map in the Noranda report

Much of the rock in the Chadbourne dump can be milled

The Alderson camp at Lake Fortune, west of Rouyn

to put in about sixteen hours a day. The inclined shaft is nearly 100 ft. deep.

Two miles beyond, on the Noranda Corduroy Boulevard, is the Chadbourne. The sizeable dump is shown in the accompanying photograph. The two-compartment shaft is 150 ft. deep, and crosscutting and drifting is the program. A boiler plant, compressor, and hoist comprise the heavy equipment. A total of 1,915 ft. of surface trenching and 438 ft. of rock trenching exposed an excellent showing on the surface before sinking was undertaken.

Another two miles brings the traveler to the "City" of Rouyn, on the shores of Lake Osisko. When Mr. Weir was there the settlement consisted of just six log cabins, including the hotel which Jimmy Greene has named the Waldorf-Astoria. How many buildings have gone up since, I cannot say, but plenty of timber is at hand, and a small town should spring up rapidly.

The principal work on the Horne consists of trenching and diamond drilling, the figures that I have quoted being based on the results of this work. A total of 5,829 ft. of core had been obtained from twenty-three holes spread over an area 700 by 300 ft. up to March 31, 1924. Most of this has been done on the E. J. Miller claim, but some holes have been drilled on claims farther south. Plans for the sinking of a shaft were made, but I understand that this has been postponed pending the outcome of further drilling, which may indicate the advisability of changing the proposed location.

These six cabins were the beginning of the city of Rouyn

The Noranda company has a well-equipped assay office in charge of Carl Erickson, of the Michigan College of Mines. This is the only office in camp as yet. L. K. Fletcher is resident superintendent in charge of operations. The managing directors are S. C. Thompson and W. H. Chadbourne.

Diamond drilling has been done on various other claims on a small scale. C. H. Hitchcock, representing Smith & Travers, of Sudbury, has conducted this work on a contract basis, the price being about $4.50 per ft. The nature of the deposits is such that diamond-drill cores give a maximum amount of information in proportion to the cost.

A large area lying south and west of Lake Osisko has been optioned by a group identified with the Hollinger Consolidated interests, of Porcupine, headed by Noah A. Timmins. It is reported that J. Macintosh Bell, of the Keeley mine, in South Lorrain, is interested in the operations of this group. If so, he is probably acting in behalf of British interests.

On one map of the Rouyn area I find the names Dome, La Rose, Huronian Belt, Coniagas, and McIntyre, attached to claims situated from 4 to 10 miles from the Horne property. These familiar names are at least indicative of the general interest in the district on the part of established companies.

The Farrell claim lies south of Lake Osisko. Its owners, Charles Farrell and Mike Kinsella, are old-time miners who have worked in Butte, the Coeur d'Alene, British Columbia, and other Western camps. They are among the pioneers and builders of Rouyn. The Keith Roberts claim lies beneath Lake Osisko except for a tiny island where Bert MacDonald and Gus O'Donell make their home. They call it the Port of Missing Men. Their latch string is out to anybody, any time.

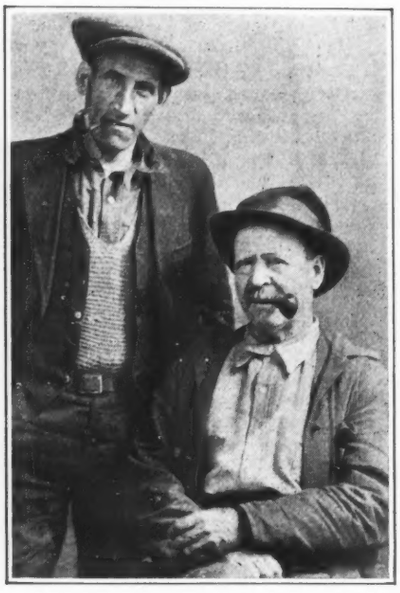
Three topics of discussion naturally are transportation, power, and smelting. The local geography is indicated on the accompanying sketch map, drawn after the map in the Noranda report. It shows the winter road from Dane and two water routes, usable in summer, from the site of the Quinze power development. For large-scale operations a railroad is necessary. The Canadian Pacific branch to the Quinze Dam reaches to a point within 55 miles of Rouyn, and the construction would be comparatively cheap. The gap of 40

The Port of Missing Men, in Lake Osisko

Trenching is the first step in prospecting a claim

miles from Rouyn to Makamik, on the National Railways, will ultimately be closed, thereby serving a large area of farming and timber land.

From the west, the T. & N. O. expects to have its branch line from Swastika to Larder Lake finished by fall, and surveys are being made between Larder Lake and Rouyn. At least one of these projects will doubtless be completed. Meantime, it seems that airplanes have been used to carry passengers and even a much-needed hoisting rope from Haileybury to Rouyn. As to power, the completion of the Quinze project will afford reasonably-priced hydro-electric energy by the time large mining and metallurgical



Mike Kinsella (left) and Charles Farrell, pioneers of Rouyn

plants could be completed and made ready for operation.

The presence of 8 or 10 per cent copper in most of the ore developed to date complicates the problem of exploitation because of metallurgical considerations. Twenty-dollar gold ore that can be cyanided readily, with the production of bullion ready for the mint, is quite different from copper-gold ore such as the Noranda company has been drilling. This ore suggests concentrators, smelters, or perhaps leaching plants. The operators around Rouyn recall the early days of Cobalt, when the complex silver ore was considered a smelting proposition. But metallurgists found a way to dissolve the silver and produce bullion without smelting the ore.

I am told that representatives of the Consolidated Mining & Smelting Co. of Canada are now in the Quebec camps, presumably to survey the situation from the standpoint of ore treatment. Whether anything comes of their investigation, it is clear that the Canadian folks are not asleep; they are early on the ground to take advantage of whatever may develop.

Rouyn as yet has no mines in a strict sense, but it has unusual prospects, and its chance of developing into an important mining district seems excellent.

Copper Smelter at Trail, Idle Two Years, Blown In

AFTER having been idle since May, 1922, one copper blast furnace has just been blown in at the Trail smelter of the Consolidated Mining & Smelting Co. It will be used to matte Rossland concentrate. Sufficient ore is being produced to maintain one furnace in operation.

The Consolidated company is making several important additions to the equipment at the smelter; these include three Dwight-Lloyd sintering furnaces, two Cottrell plants, and an antimony refining plant. In the past the antimony residues obtained in the refining of lead bullion by the electrolytic method have been sold after the removal of the precious metals. The addition of the Cottrell plants is due, probably, to the result of the finding of the Arbitration Court in the claims for damage from smelter fume against the company.

At the Sullivan mine the Consolidated company is installing four six-ton electric locomotives, a 6,000-cu.ft. Rand compressor, geared directly to a Westinghouse motor, and a Hardinge ball mill.

Mines in Eastern British Columbia to Have More Power

The West Kootenay Power & Light Co. is applying to the Provincial Government of British Columbia for the right to store 678,500 acre-feet of water in Kootenay Lake, which is equivalent to raising the lower water level of the lake 6 ft. above the present low-water level. The company's intention is to erect a dam at Granite capable of holding the lake waters to the extent indicated. This development will enable the two plants at Bonnington Falls practically to double their present power capacity. They then will be able to develop about 110,000 hp. This additional electrical production is demanded by the constant growth of the smelting industry at Trail and the increased requirements of mining and general enterprise in the east and southern parts of the province.

Coeur d'Alene Hopes To Have Rich Gold-Quartz Mine

The Murray Gold Syndicate is developing a promising gold ledge near Murray, Idaho, in the Coeur d'Alene district, which was discovered in an unusual way. Prichard Creek, famous as the scene of the first discovery of gold which placed the Coeur d'Alene district on the map, is covered by a string of placer claims for a distance of 12 miles, patented and owned by the Coeur d'Alene Placer Co. This ground is leased to the Yukon Gold Co., and for several years the company's big steel dredge has been tearing up the earth down to bedrock and leaving great winrows of boulders in its wake.

About two years ago, while digging its way up the creek a short distance below Murray, the steel buckets came up loaded with quartz literally gleaming with gold. This continued for several weeks before news leaked out regarding the discovery of a rich gold ledge. Although on ground held under patent as placer, the Coeur d'Alene Placer Co. promptly covered it with quartz claims to avoid any question of validity of location. The Murray Gold Syndicate was organized to develop the property. A shaft has been sunk 110 ft., from the bottom of which a crosscut is being run to the vein with the full expectation of striking a rich orebody.

Alaska Palladium Co. Ships Concentrate Worth 20c. Per Pound

J. E. Chilberg, president of the Alaska Palladium Co., operating the Saltchuck mine, 35 miles from Ketchikan, B. C., says that palladium concentrates can be shipped to the refinery at Irvington, N. J., more satisfactorily by the Canadian National Ry. from the town of Prince Rupert than from Seattle or other Pacific ports.

It is said by Mr. Chilberg that the Saltchuck mine has developed about six years' supply of ore, at the present rate of exploitation, and that at present about fifty men are employed. He says, further, that the average shipment amounts to between 30,000 and 35,000 lb. at a gross value of about 20c. per pound.

Gold "Showing" Near Park-Utah

A discovery of gold ore is reported in the Kamas Hills near Park City, Utah, east of the Park-Utah mine. Three young men of the neighborhood, having discovered rock, which appeared to them to carry mineral, had assays made of the material, which was found to carry gold. These young men—Erwin Peterson, Del Simpson, and Will Oliver—with others have located fourteen claims, and have formed a company, the Bonanza Gold & Silver Mining Co.

There is a 60-ft. inclined shaft on the property, and this is stated to have opened a well-defined vein, with quartz hanging wall and porphyry footwall.

Calumet & Hecla Proceeds With Big Construction Projects

Construction work is proceeding at Calumet & Hecla Consolidated's reclamation plant on the Tamarack conglomerate sands, in the Michigan copper district. The trestle for the launder from the outer edge of the sand deposit to the plant is being built, and in the interior of the plant itself the installation of equipment is well on toward completion.

This plant probably will not resume operation until the metal market strengthens. Good progress is being made on the construction of the fuel-pulverizing plant at the Calumet & Hecla smelter. The pulverizing plant, which will feed the furnaces with pulverized coal, will be completed this summer. It should effect a saving of 30 per cent or more in the fuel cost of smelting.

Coeur d'Alene Profits $5,165,262 on $21,557,673 Gross Value

Big Improvement Over 1922—Hecla Figure Includes $468,493 Insurance Money—Bunker Hill Leads

Mines of the Coeur d'Alene district, in Idaho, earned net profits in 1923 amounting to $5,165,268, as shown by annual statements filed in the office of the county assessor as required by the Idaho law. Under this law the net profits of mines are subject to tax on the same basis as real and personal property, the only difference being that whereas the tax on property is levied on a basis of 40 or 50 per cent of its value, net profits are taxed on 100 per cent basis. Mining companies are of course also subject to the property tax. The form of report required includes tons of ore produced, gross value, cost of extraction, freight and treatment, betterments and repairs, and net profit or loss. The figures below give the gross value of ore produced and net profits of the several mines:

	Gross Value	Net Profit
Bunker Hill and Sullivan	$5,968,275	$2,010,042
Caledonia	135,936	43,902
Sierra Nevada	2,123	33,293
Hecla	2,880,767	916,758
Federal (Morning mine)	4,778,360	796,451
Federal (Frisco mine	62,266	6,752
Federal (Wyoming mine)	3,195	542
Success	709,711	13,207
Tamarack and Custer	1,872,842	380,049
Hercules	3,122,773	762,044
Callahan	1,254,991	41,883
Yukon Gold	1,321,626	160,339
Totals	$21,557,673	$5,165,262

These figures of production and profits show a striking improvement in mining conditions in the Coeur d'Alenes in the last three years. In 1921 the gross value of output was $10,954,019 and net profits were $1,883,337. In 1922 the gross value was $13,809,856, with net profits of $3,587,793. The record so far in 1924 indicates a large increase in production and profits over 1923.

It is interesting to note that the gross value of output credited to Hecla in the foregoing figures includes $468,493 received from "use and occupancy" insurance carried by the company at the time of the fire last July.

Pinto Valley Company Purchases Two New Churn Drills

The Pinto Valley Mining Co. has purchased two new churn drills, which are to be put into operation on the property as soon as they are received from the factory. This company, which is developing a large area just southwest of Miami, Ariz., was recently organized and acquired the claims held by the Castle Dome, Arizona National, and Pinto Valley companies. One churn drill is now in operation, the construction of warehouse, shops, boarding house, and garages is under way, and preparations are being made to carry out the large program of development that was recently announced by the company.

Senator Ferris, Michigan Democrat and "Free Trader," Supports Copper Tariff

SENATOR W. N. FERRIS, Democrat, of Michigan, will support the copper tariff bill introduced in the House by Congressman James. He has written Mr. James to that effect. The bill would impose a duty of 6c. per lb. on all forms of copper imported into the United States and entering into competition with American produced metal.

Senator Ferris is opposed as a matter of political principle to high protective tariffs, but says in his letter to Mr. James that "there are times when a protective tariff is defensible," and "I believe your bill is justifiable."

The attitude of Senator Ferris is pleasing to proponents of the measure, for it is recognition of the non-political character of the bill, which, it is contended, is based solely on economic necessity.

South Lorrain Railway Construction Under Way in Ontario

Construction of the South Lorrain branch of the Temiskaming & Northern Ontario Ry. is now under way, the work having just been started without formal ceremonies. It will be pushed without delay, as there is a clause in the contract providing for its completion by Sept. 30.

The route follows generally the valley of the Montreal River, and as it passes through a silver-bearing area the new railway will make possible the development of many claims along the lines in addition to providing transportation facilities for the South Lorrain mines.

Hercules Controls Western Union Mine, in Idaho

It can now be authoritatively stated that the Hercules Mining Co. owns the control of the Western Union Mining Co., this being a matter upon which there has been much speculation for several months. Both companies own property in the Coeur d'Alene district in Idaho. About six months ago there was a flurry in Western Union stock, the price rapidly advancing from around 10c. to upward of 40c., with a buyer for all that was offered. It was believed at the time that it was the Hercules people who were back of the buying and that they secured sufficient stock to give them control before the price receded to its normal level.

The Western Union mine is about two miles northwest of Wallace. It first came into prominence about three years ago when leasers struck a remarkably rich body of ore, from which they derived a comfortable fortune. Since that time the company has sunk a shaft 110 ft. from the main tunnel, from which an oreshoot 300 ft. long already has been developed. Shipments of lead-silver ore have to a great extent paid for development.

Chief Consolidated Treatment Plant Nears Completion

Development Work Increased Largely—Earnings $68,348 During First Quarter—Richer Ore Mined

The Chief Consolidated Mining Co., of Eureka, Utah, is making good progress with the construction of its new reduction plant and the management hopes to start it in August. Net operating profits were $68,348 in the first quarter of 1924. During that period development increased 80 per cent, not including footage by prospect drilling. The average net value of the ore per ton increased $1.50; and the tonnage mined increased by 1,419 tons.

There were shipped 25,246 dry tons of ore, the metallic content of which was 3,393 oz. of gold, 489,842 oz. of silver, 5,361,559 lb. of lead, 225,939 lb. of copper, and 49,462 lb. of zinc.

The average net value of the ore shipped from the different properties of the Chief group was: Chief Consolidated, $21.08; Grand Central, $13.50; Gemini, $16.20; and Eureka Hill, $14.54. The total of development amounted to 21,135 ft. This kind of work is being increased to compensate for the period of forced production, when the Pittman Act was in operation.

Quincy, in Michigan, Will Increase Output to Lower Costs

Efforts will be made this summer to bring the underground force at the Quincy mine, in the Michigan copper district, up to normal in Nos. 2 and 6 shafts, the only ones producing. These shafts, which are operating 85 per cent of capacity, now have a steadier and more efficient force than a few months ago. With a full complement of men, costs will decrease.

The labor situation at Quincy has been more satisfactory of late, with steady accessions to the ranks. With both shafts working at capacity, a reasonable advance in the price of copper should put Quincy back into the dividend paying class, inasmuch as the bottom levels are rich in copper, both vein rock and mass. Quincy's yield is close to 24 lb. per ton of rock treated.

Cobalt and Arsenic Found in Calaveras County, Calif.

A discovery of cobalt and arsenic ore has been made on the extension of the Sheep Ranch vein where it intersects the Old Washington vein near Sheep Ranch, Calaveras County, Calif. The ore occurs in the form of boulders. Further exploration is being conducted to discover the source of the rich boulders.

Ohio Again an Iron-ore Producer

After a lapse of a quarter of a century, the State of Ohio re-entered the ranks of the iron-ore producers when shipments were started during May from the Thomas Maher farm, near New Lexington. A 5-ft. bed of ore has been uncovered by steam shoveling, and shipments have started to the American Rolling Mills furnaces at Columbus.

News from Washington

By PAUL WOOTON
Special Correspondent

Senate Unanimously Passes Bill Requiring Purchase of 14,589,730 Oz. of Pittman Act Silver

Senator Pepper Prepares Report—Reviews Situation and Rebukes Treasury—Substantiates Contention for Which Senator Pittman Has Fought Persistently

WHAT is equivalent to a rebuke to the policy followed by the Treasury Department in the interpretation of the Pittman Act was administered by the Senate when it passed, without a dissenting vote, another Pittman bill directing the purchase of 14,589,730.13 additional ounces of silver. The dissatisfaction of the Senate with the failure of the Treasury Department to comply with the Pittman Act was emphasized further by the fact that the bill was recommended unanimously by the Banking and Currency Committee and by the fact that the committee's report was written by Senator Pepper, of Pennsylvania, one of the Administration leaders. Senator Pepper's report contains an unusually concise statement of the situation surrounding the controversy. It follows in full:

1. Prior to April 23, 1918, the United States Treasury held over 400,000,000 coined silver dollars.

2. On that date Great Britain urgently needed silver bullion to meet demands in India for the redemption in silver of Indian rupee currency. The United States Treasury supply was the only ample supply out of which this need could have been promptly satisfied. It has, in fact, taken several years for silver production in the United States to produce an equivalent amount of silver.

3. Great Britain applied to the United States for a sale of the required silver. The act of April 23, 1918 (the Pittman Act), was passed to authorize the sale. By its terms the Secretary of the Treasury was empowered "to melt or break up and to sell as bullion not in excess of 350,000,000 standard silver dollars." The price was fixed at not less than $1 for each ounce of silver one thousand fine.

4. Pursuant to this authority $270,232,722 were broken up, and 200,032,326 oz. were sold to Great Britain.

5. Against the silver in the Treasury there were outstanding silver certificates in active circulation. It was necessary to replace for their protection the silver sold, or to be sold, under the act. It was accordingly provided in the act (section 2) that upon every sale the Secretary of the Treasury should direct the purchase from domestic producers 371.25 grains of pure silver for every dollar sold under the act. The purchase price was fixed at $1 per ounce.

6. The sale to Great Britain did not exhaust the limit of silver sales specified in the act, section 3 having authorized certain other purposes for which sales might be made. One of them was to provide the Government with silver for subsidiary coinage, the act specifically providing in said section that allocations of silver to the Director of the Mint should be regarded as sales or resales as the case might be. This statutory definition must, of course, control.

7. Having sold silver to Great Britain, the Treasury proceeded to make replacing purchases of silver produced in the United States. This could not be done at once, because the domestic price was then above the statutory limit. But it was done in due course, and no question arises in connection with that part of the transaction.

8. For the purpose of subsidiary coinage, however, the Treasury made five allocations of Treasury silver. These ranged in date from Sept. 7, 1918, to Dec. 18, 1920. Three of them were allocations of silver dollars, aggregating 11,111,168. Two of them were for an aggregate of 6,000,000 oz. of bullion. This makes a total of 14,589,730.13 fine ounces. Each allocation directed the director of the mint to purchase for replacement an equivalent quantity of silver bullion at $1 per ounce. But no purchases of domestic silver were in fact made to replace the silver which was the subject of these statutory "sales." On the contrary, at a later date the Treasury undertook to revoke the allocations. But the evidence offered at the committee hearings shows that such revocations were made 13 months and 23 months, respectively, after the date of the last allocation and after the silver bullion contained in the 11,111,168 silver dollars had been converted into subsidiary coinage and after 1,658,976.62 fine ounces, included in the last two allocations of fine silver, had also been so converted. The question before the committee is whether the revocations were in accordance with the mandate of Congress as expressed in the Pittman Act, and the committee is of opinion that they were not.

9. The action of the Treasury, as being in harmony with the law, is supported by a decision of the Comptroller General. This opinion, however, is merely advisory. The theory of both the Treasury and of the Comptroller General is based upon the claim that there had been at all times a quantity of free silver in subsidiary coinage accounts of the mint service in excess of the quantity allocated under the Pittman Act for subsidiary coinage. But, whatever the fact, the silver bullion on hand was not the identical silver allocated. It is said by the Treasury and by the Comptroller General that the coinage which in fact took place after the allocations may be regarded as having been made out of free Treasury silver available for the purpose and not out of the allocated silver; but this contention is not sustained by the evidence taken by the Special Commission of Gold and Silver Inquiry. The question therefore becomes this: Are allocations under the Pittman Act which by its terms are treated as sales or resales revocable by the Treasury once they are made? Or does the duty of the Treasury to direct replacing purchases arise eo instanti the allocation is made?

10. It is clear that no individual (i.e., no would-be vendor of silver) has legal right under the act. It is purely a question whether Congress intended to give the Treasury discretion in the premises. It is natural for the Treasury to contend for discretion. While it is contended that the purchase of the silver bullion required by this bill would cost the Treasury $5,000,000 over and above the present market price, it must not be overlooked that, as the Pittman Act requires this silver to be coined into standard silver dollars at 1.29, the actual gain to the Treasury is 29 per cent of the amount involved or a total profit of $4,231,021.73. Obviously, those who framed and pressed for the passage of the act were determined to eliminate Treasury discretion or at least to limit it to the making or not making of allocations. In other words, the act appears to the committee to have been an act to compel repurchase of domestic silver and not an act to conserve the resources of the Treasury. Whether it was wise or unwise to pass an act framed on this theory is not the function of the committee or the Treasury Department to decide. It is clear that the true intent and purpose of the act would be defeated if allocations under it were treated as revocable. Therefore the enactment of S. 2017 is essential to the due and proper execution of the Pittman Act according to its true intent and purpose.

Big Demand for Arsenic Expected by Federal Specialists

Though the demand for calcium arsenate is expected by government specialists to be strong again this year, there are various indications that the manufacture of this important insecticide gradually is becoming more stabilized. One of the stabilizing factors is the fact that fully 50 per cent of the country's requirements are covered by contracts. In some instances contracts have been placed through farmers' co-operative organizations.

If and when spot buying becomes brisk, it is believed that production will increase rapidly. Stocks of raw material are larger than for several years, and the manufacturers are in a position to maintain capacity production for a considerable period. Their stocks are not sufficient, however, to turn out all of the product which will be needed, but early buyers will be able to secure prompt deliveries.

To the expansion in the domestic production of white arsenic is being added a gradually mounting volume of imports. Japan's recent heavy shipments of white arsenic have come as a surprise. Apparently the Japanese have been preparing quietly for this production. Exact information as to the source of the Japanese supplies is not at hand, but the knowledge that they are seeking contracts for a larger volume of arsenic than they are shipping at present is believed to indicate that they are in a position to furnish more than had been anticipated.

Bolivian Tin Industry Thrives

The decline in the price of tin is not affecting the industry in Bolivia, according to advices to the Department of Commerce. Within the last month the combined Llallagua-Unicia properties have started production. This consolidation of properties was effected by an American company with a combined capital of $10,000,000.

Production has also been resumed at the El Salvador operation, which has been reorganized.

London Letter

By W. A. Doman
Special Correspondent

Why Have Globe & Phoenix Shares Climbed to 17s. 3d.?

Question Puzzles Public and Rhodesian Exploration Co.—Latter Owns Adjoining Ground

London, May 20—Developments at the Globe & Phoenix mine, in Rhodesia, are becoming interesting. The shares of the company, which are of the nominal value of 5s., have risen to 17s. 3d. (though they have been higher), and no explanation has been forthcoming. Crosscutting in a northerly direction from the fourteenth level has been in progress for some months. At the annual meeting of shareholders in March it was officially reported that the hope was entertained of cutting a reef soon, and as about 300 ft. must have been accomplished since that date, the jump in the price of the shares is regarded as indicating the fulfillment of hope.

As far as can be gathered from a glance at a surface plan of the property, the Globe & Phoenix ground where the crosscutting is proceeding is not more than 300 ft. across. If this be so, and a reef is intersected, it would appear to be in an area belonging to another company, possibly the old enemy, the Rhodesia Exploration Co. This would not be a case of extralateral rights; it would come under the heading of striking a secondary reef, and the reef would have to be registered as such.

Rhodesia Exploration shareholders are becoming a little restive, and wondering what is happening. It is not likely that the Globe & Phoenix management would trespass. From the trend of the reefs in the Globe & Phoenix it was long ago officially stated that the Rhodesia Exploration ground to the north was vital to the company. H. G. Latilla, the chairman of the Rhodesia Exploration Co., was in Rhodesia a few months ago, and according to rumors he said that if the Globe & Phoenix directors wanted to transact business, they could negotiate with him. If he is not an expert himself, he is advised by clever engineers.

At the time Mr. Latilla was in Rhodesia, Leslie Urquhart was also there, and visited and reported upon the Cam & Motor mine on his return to London. His report consisted largely of recommendations. On the document reaching the mine, the technical management was not too pleased with its tenor, and has issued a long statement in reply, pointing out that Mr. Urquhart's suggestions had in the main already been put into effect.

The Rhodesian Congo Border Concession makes the important announcement that a discovery has been made on the eastern side of the concession of a porphyry formation carrying, so far as it has been possible to investigate it, a relatively high percentage of copper. The geological formation has been traced for an exceptionally long distance, and samples taken from surface trenches and from shafts at a depth of 50 ft. have proved the existence of sulphide copper ores. This is the first discovery of its kind in Africa, and "good ground for the hope that further work will disclose that good copper values exist over a large area."

Gold, manganese, and graphite have also been located. In addition, a new copper orebody has been discovered, and according to the engineer there has been no discovery in Northern Rhodesia that shows so much copper in the surface clays at grassroots.

Germans Deny Acquisition of Turkish Copper Mine

Recent reports that the largest Turkish copper mine, the Arghana, had been acquired by a German consortium to which the Deutsche Bank and the Stinnes group belong, are contradicted in Germany. It is said that Turkish negotiators have been in Berlin, but that German metal producers showed little interest in the matter.

Dredge Sinks on Klondyke River

Telegraphic information from Dawson City, in the Yukon, is to the effect that Burrall & Baird's No. 4 dredge sank in 25 ft. of water at a point between Hunker and Bear creeks, in the Klondyke River, on May 17. At the time of sinking the dredge was being re-conditioned for summer work. The cause of the sinking is unknown.

The dredge was built in 1912 at a cost of $100,000. It has a capacity of 10,000 yards per day, and when it was built was said to be the largest dredge in the world.

U. S. Smelting Discontinues Drilling at Eureka; Says Nothing

The United States Smelting, Refining & Mining Co., owner of the Richmond-Eureka mine, at Eureka, Nev., has discontinued diamond-drill work from the 900 level of its Locan shaft and the equipment is being removed. This work was being done to prospect for the faulted continuation of the rich orebodies mined in the early days of the district to the northeast of the Ruby fault. It is reported that difficult drilling formation retarded the progress of the work. No information is available at present to show what was accomplished, or what the future development plans of the company may be.

$100,000 for New Equipment and Development at 85 Mine

The sinking of the main shaft of the 85 Mine, at Lordsburg, N. M., will be continued to the 1,800 level and new pumping equipment will be installed, It is reported that approximately $100,000 will be spent at once in new equipment and development work. Ore shipments will continue at the usual rate of 9,000 tons monthly.

R. H. Dickson, for the last four years chief engineer for the C. & A. company, at Bisbee, Ariz., and who has been connected with that company since 1912, has been made general manager.

Johannesburg Letter

By John Watson
Special Correspondent

Reorganization of Simmer & Jack Effected with Capital Increase

£250,000 Required to Open 542 New Claims—Should Add Many Years to Life of Property

Johannesburg, April 28—An extraordinary meeting of Simmer & Jack shareholders was held on April 24, when a proposed reconstruction plan was adopted. By the new arrangement the capital will be £625,000, divided into 5,000,000 shares of 2s. 6d. each, the shareholders of the proprietary company receiving one 2s. 6d. share for every £1 share held. The remaining 2,000,000 shares will be offered to shareholders at par, the subscription of these 2,000,000 shares being guaranteed at par (2s. 6d.) by the New Consolidated Gold Fields, Ltd. The new company will take over the proprietary company with all its assets and liabilities as a going concern as from Jan. 1, 1924.

It is understood that £250,000 is required to de-water and open up an additional 542 claims immediately adjoining the southern boundary of the present property. The acquisition of these new claims is estimated to assure a further life of seventeen to eighteen years for the property, whereas the life of the old mine was estimated at two to two and a half years.

The Anglo-American Corporation of South Africa has just issued its reports for the annual meetings of its companies to be held next month. A comparative table of results at Brakpan Mines shows:

	1921	1922	1923
Tons milled...	659,800	549,748	786,100
Total working profit.....	£490,246	£439,836	£611,448
Working costs per ton milled.....	27s. 2.36d.	23s. 10.05d.	21s. 5.08d.

The revenue for 1923 included £5,574 from the sale of osmiridium.

At Springs Mines, the following results have been obtained:

	1921	1922	1923
Tons milled...	484,750	424,090	648,600
Total working profit.....	£397,803	£347,117	£621,837
Working costs per ton milled.....	29s. 8.36d.	24s. 2.36d.	22s. 5.96d.

At Springs, the all-sliming method has been installed, six tube mills being added and the slime treatment plant extended. The new plant was completed in December last, and resulted in 63,000 tons being milled in January. The consulting engineer, Carl Davis, says the all-sliming plant functioned efficiently, a substantial saving resulting from decreased operating costs and increased extraction of gold.

At West Springs, the new reduction plant should be operating in May. It is intended to produce a one-product pulp by means of single-stage crushing and tube milling. Cyanide solution will be introduced during the tube-milling stage; the slime treatment includes a Butters filter plant with a Merrill-Crowe zinc-dust precipitation plant.

Societies, Addresses, and Reports

Good Opportunity for Young Graduates in Metallurgical Research

U. S. Bureau of Mines Offers Fellowships in Co-operation with Various Universities—Pay From $540 to $800 per Year

Graduate fellowships in mining, metallurgical, and chemical research are offered by various institutions of learning, in co-operation with the Bureau of Mines. The purpose of these fellowships is to undertake the solution of various problems being studied by the Bureau of Mines that are of especial importance to the regions in which the institutions of learning are situated. They afford excellent opportunities for qualified young men to become experts in the fields of mining and metallurgy and to prepare themselves for highly technical work in these various technical fields.

For the college year 1924-1925, the following institutions offer such fellowships: University of Alabama, Tuscaloosa, Ala.; University of Arizona, Tucson, Ariz.; Carnegie Institute of Technology, Pittsburgh, Pa.; University of Missouri, Rolla, Mo.; Ohio State University, Columbus, Ohio.; University of Utah, Salt Lake City, Utah.; University of Washington, Seattle, Wash.; University of Idaho, Moscow, Idaho.

The value of the fellowships offered by the University of Alabama is $540 per annum. At this institution five fellows were appointed for the college year 1923-24, whose investigative work related to the washing of Alabama coals and the beneficiation of low-grade brown, red hematite, and gray specular hematite iron ores.

The University of Arizona offers fellowships of a value of $750 per annum. Previous work performed by fellows at this university has related to the selective flotation of copper sulphide minerals and the leaching of heavy sulphide cupriferous ores with ferric salts.

The value of the fellowships of the School of Mines and Metallurgy of the University of Missouri is $800 a year. In 1923-24 two fellows studied the influence of time, temperature, and rate of cooling on mine-drill steel, and the effect of various factors on the rate of reduction of zinc compounds by carbon.

The University of Utah fellowships are valued at $720 per annum. In 1923-24 five fellows studied the utilization of Utah hydrocarbons; the hydrometallurgy of zinc; ore-dressing problems; and the geology and microscopic examination of complex zinc ores.

The University of Idaho fellowships are valued at $750. In 1923-24 the fellows at this institution studied the treatment of various gold-silver ores.

Detailed information in regard to these fellowships may be obtained from the Department of the Interior, Bureau of Mines, Washington, D. C., or from the various institutions named.

First-Aid and Mine Rescue Meet To Be Held at Huntington

Invitations to attend and participate in the fourth international first-aid and mine rescue contest, to be held at Huntington, W. Va., Sept. 11, 12, and 13, have been sent out by the U. S. Bureau of Mines to the coal and metal mining companies of the country, to quarry operators, metallurgical plants, and others at home and abroad. The West Virginia Department of Mines, the Huntington Chamber of Commerce, the American National Red Cross, the National Safety Council, and various mine operators' associations and miners' organizations will co-operate.

Third Pan-American Congress Organized

Will Meet in Lima, Peru, Next November—Institutions and Scholars Invited to Contribute

The Third Pan-American Congress will convene in Lima, Peru, Nov. 16 next, under the auspices of the Peruvian Government. All branches of science, particularly those concerning the continent of America, will be admitted to the sessions, which will last over the following fortnight. The organization committee consists of Dr. Manuel Vicente Villarán, rector of the University, chairman; Dr. Alejandro O. Deustua, dean of the faculty of letters and director of the National Library; and José J. Bravo, president of the Peruvian Association for the Advancement of Science, secretary.

The Congress will be divided into nine sections as follows:

1. Anthropology, history, and related sciences. Chairman, Dr. Felipe de Osma, president of the Historical Institute of Peru.
2. Physics, mathematics and related sciences. Chairman, Rear Admiral M. Melitón Carbajal, president of the Geographical Society of Lima.
3. Mining, metallurgy, economic geology and applied chemistry. Chairman, José Balta, professor of economic geology at the Lima School of Engineering.
4. Engineering. Chairman, Dario Valdizán, dean of Peruvian engineers.
5. Medicine and sanitation. Chairman, Dr. Guillermo Gastañeta, Dean of the Faculty of Medicine.
6. Biology, agriculture and related sciences. Chairman, Dr. Wenceslao F. Molina, Dean of the Faculty of Sciences.
7. Private, public and international law. Chairman, Dr. Mariano Ignacio Prado y Ugarteche, Dean of the Faculty of Jurisprudence.
8. Economics and sociology. Chairman, Dr. José Matías Manzanilla, Dean of the Faculty of Politics and Economics.
9. Education. Chairman, Dr. Alejandro O. Deustua (named above).

Dr. Cristóbal de Losada y Puga is assistant secretary of the Congress.

The cultural institutions and scholars of the American continent have been invited to take part in the proceedings.

Blaylock Awarded Gold Medal by Toronto University

The governors of Toronto University have awarded the McCharles gold medal and prize of $1,000 to S. G. Blaylock, managing director of the Consolidated Mining & Smelting Co. of Canada, in consideration for his researches leading up to the production of electrolytic zinc and the successful treatment of the refractory silver-lead-zinc ores of the Kootenays.

In accepting the prize, Mr. Blaylock wrote: "While expressing my appreciation and gratitude for the honor done me, I feel that I must make it quite clear that I would like to accept the medal as a captain of a team who worked out these problems. Many of the vital parts of the processes were worked out by other members of the staff. Much credit should be given in the electrolytic zinc development to Messrs. F. E. Lee, R. H. Stewart, the late J. K. Batchelor, B. A. Stimmel, G. Cruikshanks, and F. E. Willis; in the development of lead smelting processes, to smelt the various products, to Messrs. James Buchanan and C. E. Murray; and in the concentration of the ores to Messrs. R. W. Diamond, W. H. Hanney, and C. T. Oughtred. The money part of the prize will be donated to the Trail memorial building, in which all the staff are interested."

Lake Superior Mining Institute May Visit Ontario

The Lake Superior Mining Institute may change the place of its annual meeting next August from the Marquette iron range to the Sudbury, Cobalt, and Porcupine mining camps in Canada. Many of the members have not visited these districts, and there is a widespread desire to make the trip this year. The Institute council probably will decide the matter soon, and it is believed its decision will be in favor of the Canadian camps.

The Marquette range has been frequently visited and the majority of the membership is familiar with it.

Chemical Industries Plan 1925 Exhibition

The next national exposition of chemical industries is more than a year off, but plans are being actively made for it. Many requests for space have already been received at the offices of Tenth Exposition of Chemical Industries, Grand Central Palace, New York City. The week of Sept. 28 to Oct. 3, 1925, has been selected for this affair.

Globe-Miami Rescue Maneuver To Be Held June 10-11

The Globe-Miami District Mine Rescue and First-Aid Association, of Globe, Ariz., will hold its fifth mine rescue maneuver on June 10 and 11. These maneuvers are held in an isolated section of the surface workings of the Old Dominion mine. The sixty-man rescue crew, with station equipment and personnel, will be used to work out problems in mine rescue and fire fighting under as nearly actual conditions as possible.

Men You Should Know About

W. S. Alden has resumed his glacial studies in Montana.

J. B. Eby is examining the geologic structure in the vicinity of Baggs, Wyo.

Henry Wyman has left Mexico City, and is in Pittsburgh, Pa., on professional business.

G. L. Sheldon, of Compañia Metalifera de Coadoro, has moved his headquarters to Choix, Sinaloa, Mexico.

A. J. Collier and **C. D. Avery** are at Rock Springs, Wyo., to take up work on anticlines in southern Wyoming.

H. Nishihara has left Tokio, Japan, and is now with the Andrews & George Co., Okura Building, Dairen, Manchuria.

G. I. Finlay has begun oil investigations in the "Four Corners area" of Arizona, Utah, New Mexico, and Colorado.

James H. Lang has been appointed assistant treasurer and **E. H. Hothorn** assistant secretary of the American Metal Co.

Lester W. Strauss arrived in New York on the steamship "Santa Ana," on June 2, coming direct from Valparaiso, Chile.

T. A. Rickard delivered an address on "The Development of the Art of Mining" before the mining convention at Grants Pass, Ore., on June 2.

Dr. C. V. Corless has sailed for England and will read a paper on Canadian mineral resources before the Royal Society of Arts on June 16.

L. J. Buck, New York sales manager of the British America Nickel Corporation, sailed on June 2 for Europe, where he will first visit the Scandinavian countries.

H. W. Hoots, who has completed his work at Stanford University, will join Messrs. **Woodring** and **Roundy** in their examination of the Elk Hills district, California.

Charles Mentzel has left Toronto to visit the Clifford Gold Mines and the Gardner Guibord Gold Mines, for both of which he is acting as consulting engineer.

Charles V. Thomas, of Redruth, Cornwall, passed through San Francisco on his way around the world. Mr. Thomas is a son of the celebrated Captain Josiah Thomas, of Dolcoath.

Andre Dorfman has resigned as mill superintendent of the McIntyre-Porcupine mine, to take effect July 1. He was in charge of the recent alterations and enlargement made at the mill of the Vipond Consolidated.

Fred J. Searles, Jr., of Boston, has completed a week of field work in the Fairbanks district, Alaska, where he examined the extensive dredging project now under investigation by the U. S. Smelting, Refining & Mining Co.

Dr. Alfred W. G. Wilson, of the Mines Branch, and **Wyatt Malcolm**, of the Canadian Geological Survey, have sailed for England, having been appointed to represent the Canadian Department of Mines at the British Empire Exhibition.

Owen Letcher, mining engineer, Editor of the *South African Mining and Engineering Journal* and the South African News Service, and director of the South African *Power Magazine*, of Johannesburg, has just paid a hurried visit to the United States, returning to London, Brussels, and South Africa on the "Lancaster" on May 24. Mr. Letcher is consulting engineer to Paukwab Tin, Ltd., and Ondundu Otjiwapa Gold Fields, Southwest African Protectorate. He served in the Great War in the South African forces, in the Southwest Africa and Central East Africa campaigns, and also on the staff of the Nyasa-Rhodesian field forces. Mr. Letcher has written several technical and geographical papers, and is the author of "Big Game Hunting in Northeastern Rhodesia" and "The Bands of Africa," and has traveled and shot big game and explored extensively in Asia and Africa. He is a graduate of the Redruth School of Mines, silver medallist, Miners' Association of Dover and Cornwall, a member of the Institution of Mining and Metallurgy, London; a fellow of the Royal Geographical Society, London, and a member of the Chemical, Metallurgical and Mining Society of South Africa.

Owen Letcher
Engineer, soldier, journalist, traveler, and hunter, of Johannesburg, South Africa

Philip N. Moore, of St. Louis, was a member of the committee appointed recently by the American Engineering Council, at the request of Senator G. W. Norris, to study general economic phases of the Muscle Shoals problem.

J. A. P. Gibb, consulting engineer for Anglo-French Exploration, Ltd., of London, has been transferred from Johannesburg, South Africa. to Canada to represent the company jointly with **J. B. Tyrrell**. The company is opening an office in Toronto.

David Cole is directing the construction of a 600-ton concentration plant for the Potosi Mining Co., at Chihuahua, Chih., Mexico. He is also constructing a concentrating plant for the Sheldon Mining Co. at Walker, near Prescott, Ariz., which work is well under way.

John Knox, general superintendent for the Calumet & Hecla Consolidated Copper Co., Calumet, Mich., has resigned, effective June 1, to become assistant manager of the Hollinger Consolidated Gold Mines, Ltd., operating in the Porcupine district, Canada. He has been connected with the Calumet & Hecla interests since 1907, and became general superintendent of the company in 1911.

Robert M. Black, professor of mining at the University of Pittsburgh, has just returned with the University senior class in mining from its underground surveying trip, of which he was in charge. The party spent two weeks at the limestone mine of the American Lime & Stone Co., at Bellefonte, Pa., which was selected for the survey because of the large opportunity it offers for investigation and the study of mining problems.

James F. McCarthy, manager of the Hecla Mining Co., of the Coeur d'Alenes; **W. A. Corey**, manager of the Finch & Campbell estate, of Spokane, and **S. R. Moore**, mining engineer, recently spent ten days in the vicinity of Fairbanks, Alaska, looking over mining properties. They are developing a very promising gold property in the Totatlinika district about 10 miles from the Government Railway.

Frederick G. Clapp's expedition in search of oil left Perth, West Australia, for the northwest part of Western Australia on April 13. The region to be examined is remote from settlement, and the expedition, which will be engaged for several months, will be kept in touch with Perth by means of a wireless apparatus. The company which the expedition represents has now amalgamated with some others, having a working capital of not less than £250,000.

Philip S. Smith and **J. B. Mertie, Jr.**, of the U. S. Geological Survey, are at a camp at the head of Unakserak River, close to the Arctic divide. Mr. Smith has made a trip across the divide. This survey furnishes the first definite information of the positions of the Colville drainage ways in this part of Alaska. Messrs. **Mertie** and **FitzGerald** are to explore as far east as Chandalar Lake, and, when the river opens, to survey the upper Colville, continue their survey across the portage to Chipp River, and follow that stream down to the Arctic Ocean. Messrs. **Smith** and **Lynt** will make a winter exploration westward from the Upper Colville and will later find a portage to the upper valley of Meade River and survey that stream until they make connections with the traverse which was run by Sidney Paige last year.

Obituary

Bethuel Merritt Newcomb, a retired mining engineer, died at his home in Berkeley, Calif., on May 20, 1924.

Walter R. Skinner died recently in England. Mr. Skinner was founder and editor of the *Mining Manual* and the *Oil & Petroleum Manual*. He was in his seventy-third year.

Recent Technical Publications

Reviews, Abstracts, and References

The Elements of Ore Dressing

Ore Dressing Principles and Practice. By Theodore Simons. McGraw-Hill Book Co., New York. Price $3.50.

Theodore Simons

In the opening paragraph of his preface, Professor Simons (University of Montana) says that "this treatise is intended primarily to serve as a guide to the beginner and to the student who is desirous to learn the *why*, the *wherefore*, and the *how* of ore dressing before attempting to practice the art, and to the practical millman who may know a great deal of the *how* but not so much of the *why* and the *wherefore*." The author's aim, in my opinion, has been well carried out. In a book of 292 pages he has covered general principles of ore dressing, gravity processes of concentration, crushing and grinding, sizing and classifying, flotation and special processes of concentration, stamp milling and plate amalgamation, with an appendix giving a few representative flow sheets. As the book is printed in large type and contains numerous well-selected illustrations, there is obviously little space available for complete descriptions of all of the various types of machines used in modern ore-dressing plants, so Professor Simons has selected only one or two examples of the principal classes of equipment to illustrate how the principles of operation are applied in practice. The book, therefore, cannot be expected to be a complete reference work; for example, nothing is said about short-head gyratory crushers, vertical disk crushers, dry-grinding tube mills, concentrating tables other than the Wilfley, flotation machines other than the Minerals Separation, Callow, and Janney, bowl classifiers, tray tanks, or disk filters.

The theory of hydrauiic classification is covered at some length, and adequate attention is also given to the theory of crushing in jaw crushers, rolls, and stamps, and to the principles underlying the action of jigs and concentrating tables. When it comes to flotation, however, the author evidently feels that a book would be necessary to do justice to the various theories, so he says little or nothing.

The book is well written, with few statements that can be controverted, or typographical errors. The copper industry would be worse off than it is now if "all clays, for instance, contain from 10 to 20 per cent metallic aluminum," as the author states, but he makes few errors in expression like that. In describing a "typical plant using gravity concentration" in Chapter III, he has been somewhat unfortunate in selecting an old-fashioned plant; certainly not a typical modern one; but most of the matter is up to date. And in the chapter on ball and tube mills, the reader who did not know any better would get the idea that long tube mills, with pebbles used for grinding, are the most common machines used for preparing flotation feed, whereas ball mills, with a length less than their diameter, and using iron or steel balls, are almost universally used for this purpose.

This elementary work on ore dressing can be particularly recommended for the use of students beginning their study of this subject, or for the practical operator who, perhaps, is superintending a unit of concentrating tables, but wants to know something about other milling machinery or processes, or for the layman who wants to know something about what goes on in an ore-dressing plant. But trained metallurgical engineers will get little out of it; the author did not intend it for an advanced treatise. E. H. ROBIE.

Copper Ore Leaching—U. S. Bureau of Mines *Reports of Investigations*, No. 2,556, 7 pages, obtainable on request, is entitled "Ferric Sulphate and Sulphuric Acid from Sulphur Dioxide and Air." It is by E. S. Leaver and R. V. Thurston, and describes the conditions under which sulphuric acid is formed from sulphur dioxide solutions in the presence of iron.

Mining in India—We have received the report of the Chief Inspector of Mines in Mysore for 1922-1923. Obtainable from the Chief Inspector of Mines in Mysore, Oorgaum, K. G. F., South India, for 2 rupees. There are five operating gold mines in this part of the world: Mysore, Champion Reef, Ooregum, Nundydroog, and Balaghat. Of particular interest is the depth reached by some of the mines: at the Champion Reef mine, Carmichael's Secondary Shaft has reached a vertical depth of 6,215 ft. below field datum; and at the Ooregum mine, Oakley's No. 2 Vertical Shaft is 6,231 ft. vertically below field datum.

Oil and Gas Specifications—Technical Paper 323A of the U. S. Bureau of Mines is an 89-page bulletin devoted to the "United States Government Specification for Lubricants and Motor Fuels, and Methods of Testing." Obtainable from the U. S. Bureau of Mines, Washington, D. C. free of charge so long as its supply lasts; thereafter for 15c. from the Superintendent of Documents, Washington, D. C.

Chilean Resources—The Chile-American Association, 32 Broadway, New York City, has issued a 64-page booklet in English and Spanish on the "Reciprocal Trade and Resources of Chile and the United States." Several pages are devoted to the mineral resources and development of Chile.

Analysis of Rare Metals—Bulletin 212 of the U. S. Bureau of Mines, Washington, D. C., 325 pages, is entitled "Analytical Methods for Certain Metals," including cerium, thorium, molybdenum, tungsten, radium, uranium, vanadium, titanium, and zirconium. The authors are R. B. Moore, S. C. Lind, J. W. Marden, J. P. Bonardi, C. W. Davis, and J. E. Conley. The book is an excellent summary of methods already published, with critical comments, together with modifications and new methods developed by the Bureau in its work at the Colorado station. Obtainable free from the Bureau so long as its supply lasts; thereafter for 40c. from the Superintendent of Documents, Washington, D. C.

Ontario Mining—Bulletin No. 51, pp. 18, of the Ontario Department of Mines, Toronto, is a preliminary report of the "Mineral Production of Ontario in 1923," prepared by W. R. Rogers. Part II of the thirty-second annual report of the department, 64 pages with maps, describes the geology of the Ontario-Manitoba boundary from Winnipeg River to Twelfth Base Line. Either may be obtained on request.

Iron Ore Analyses — Clement K. Quinn & Co., Alworth Building, Duluth, Minn., have published an attractively bound little booklet of 51 pages giving guaranteed analyses and sieve tests of the various kinds of Lake Superior iron ore to be sold this year.

New South Wales Minerals—The Geological Survey of the Department of Mines, Sydney, New South Wales, has published Bulletin No. 4, 23 pages, by L. F. Harper, on "Iron"; and Bulletin No. 5, 47 pages, by E. J. Kenny, on "Antimony, Arsenic, Bismuth, Molybdenum, and Tungsten." The individual deposits are described. Bulletin No. 4 can be obtained for 1s., and No. 5 for 3s. 6d.

Washington Alumni—The State College of Washington, Pullman, Wash., has issued a directory of the students and alumni of the School of Mines and Geology, obtainable for the asking.

Zinc Smelting—B. M. O'Harra has written a paper on "Tests of Lignite Char as Reduction Fuel in the Smelting of Zinc Ores," published by the U. S. Bureau of Mines, Washington, D. C., as *Reports of Investigations* No. 2,575, 7 pages, obtainable on request. The results of work at the East St. Louis smelter of the American Zinc, Lead & Smelting Co. are given, which were favorable both from the standpoint of improving the practice of zinc smelting and of utilizing the lignite deposits of Arkansas and other Western states.

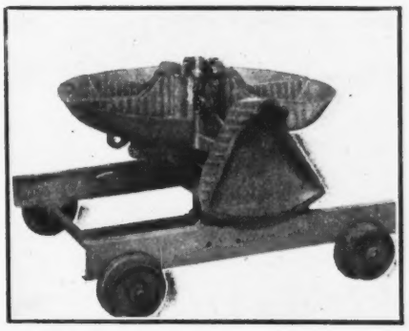
Detonators—"Methods of Testing Detonators" is the title of a 14-page bulletin of the U. S. Bureau of Mines *Reports of Investigations*, No. 2,558, by C. A. Taylor and C. E. Munroe. The investigation emphasizes the value of the sand test for estimating the strength and efficiency of industrial detonators.

New Machinery and Inventions

New Line of Switchboard Instruments Developed

A complete line of rectangular-shaped instruments, including direct-current voltmeters and ammeters, for use on switchboards controlling alternating-current machines has been developed by the Weston Electrical Instrument Co., Newark, N. J. All the instruments of the group have uniform-case size dimensions—5¾ in. wide and 6 in. high. This affords a remarkable saving in space, which has been attained without sacrificing any of the essential characteristics of the Weston round-pattern instruments. In the case of the rectangular instrument, four may be laterally accommodated on a 24-in. panel, whereas the round pattern instruments require a 32-in. panel and a greater vertical space. The ratio of space is approximately five to nine in favor of the rectangular case. A triplex ammeter, as shown in the illustration, contributes to the saving in space in those cases where an ammeter is required in each phase.

Although the new instruments occupy a much smaller space, reference to the cut shows how it was possible to preserve exactly the same scale length as in the round-pattern instruments. Further, there has been obtained a much larger scale opening, permitting better illumination and improved legibility, which is also facilitated by larger and heavier scale numerals printed on a horizontal plane. The wiring studs in the rear of the instrument have been grouped in the center and have been kept uniform on all types, so that any instrument with an equal or lesser number of studs than another can replace it without requiring new drilling. Resistors, where used, are mounted back of the switchboard on studs projecting from the rear of the instrument. These resistors have also been made correspondingly smaller.



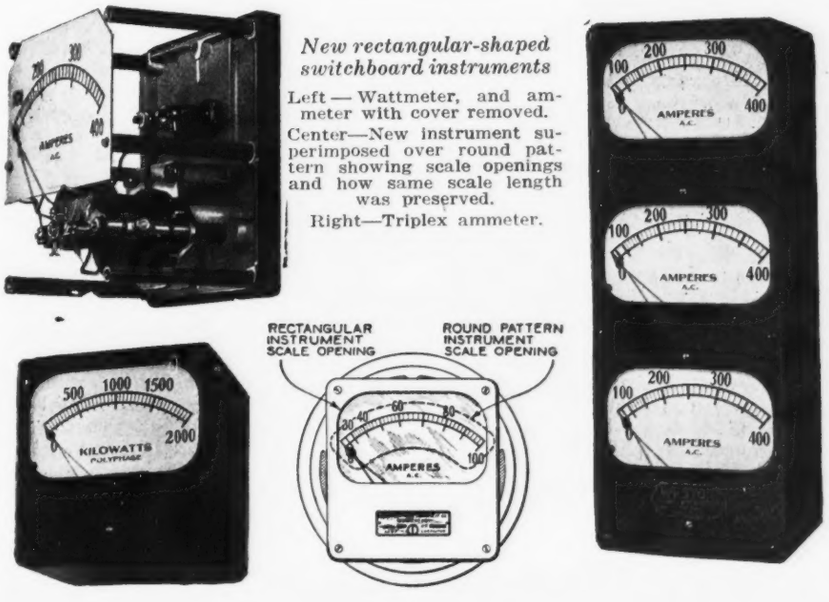
One of six shells forming body of new matte car is shown just after dumping

New Matte Car Designed for Small Furnaces

A new form of matte car has been designed by the Mace Company, of Denver, Colo., which is supplied with each installation of that company's small-unit smelting furnaces. The car runs on the same track that carries the truck of the removable crucible of the furnace.

Six matte shells, shaped as triangular segments of a circle, are carried on a revolving turntable, so that each can be turned toward the matte spout as the next one is filled. A locking device prevents premature dumping of the contents. The matte is cast in thin cakes which cool rapidly and the car is then run out and the dogs released, allowing the shells to tip automatically one by one, dumping the matte into the bin.

The matte shells have corrugated sides. The straight side shells previously used gave a great deal of trouble from cracking when loaded with molten matte, owing to expansion and contraction strains occurring unevenly. These strains are now absorbed by the corrugations of the shell, which eliminate cracking.



New rectangular-shaped switchboard instruments

Left — Wattmeter, and ammeter with cover removed.

Center—New instrument superimposed over round pattern showing scale openings and how same scale length was preserved.

Right—Triplex ammeter.

Trade Catalogs

Speed Reducers. IXL speed reducers made by Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, are described in a 14-p. illustrated catalog just issued. They are made in various sizes, from fractional horsepowers to 150 hp. in stock, and in larger sizes to order.

Aërial Tramways. The Interstate Equipment Corporation, 25 Church St., New York, describes its Automatic aërial tramway in a 4-p. catalog. This tramway is a development of the old Lawson type, with improvements which have widened its range of usefulness. Its operation is simple, requiring the attention of only the ordinary laborer.

Coal-handling Machinery. The Jeffrey Manufacturing Co., of Columbus, Ohio, has issued a new catalog, No. 385, covering its line of machinery for handling coal and ashes at power plants. This 212-p. book is bound in stiff covers, and is well illustrated. Typical layouts giving general dimensions accompany the tables of specifications for various equipments.

Air Compressors. The Sullivan angle-compound power-driven air compressor is described in detail in the Sullivan Machinery Co.'s Bulletin 77-H. A table of commercial sizes and ratings is given. The angle-compound air compressors range in size from 455 to 1,852 cu.ft. per minute displacement volume. The twin type ranges from 910 to 3,704 cu.ft. per minute displacement volume. In Bulletin 77-K the smaller single cylinder and straight-line tandem two-stage belt-driven compressors are described. These range in size from 68 to 1,472 cu.ft. per minute displacement volume.

Dry Vacuum Pumps. In Bulletin 78-B, the Sullivan WA-61 steam-driven, and WG-61 belt-driven, single-cylinder vacuum pumps are described in detail. The capacities of these pumps range from 100 to 1,600 cu.ft. displacement volume per minute.

Air Operated Spader. The Sullivan DE-361 spader is described in Bulletin 70-X. This tool consists of a light Sullivan air hammer weighing 17.5 lb. equipped with a steel spade and special retaining ring or bushing. The spader is used in pit, tunnel, and trench work for excavating stiff clay and soft ground.

Lubricators. "The Economy of Better Lubrication" is the title of a recent publication of the McCord Radiator & Manufacturing Co., 2587 East Grand Boulevard, Detroit, Mich. It contains illustrations of the company's Class B lubricator adapted to small steam engines, oil engines, gasoline engines, air compressors, steam pumps, and auxiliaries; also a complete set of over-all dimensions, price lists, and description of this lubricator.

The same company has also issued its Class BA catalog describing the part lubrication plays in the operation of steam shovels, cranes dredges, hoisting engines, and coal and ore-handling apparatus.

The Market Report

Daily Prices of Metals

May	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
29	12.50	40.25	40.75	7.00	6.75	5.825–5.875
30	.....	.....	.....	....	.....	.....
31	12.50	39.75	40.25	7.00	6.80@6.85	5.85
Ju. 2	12.50	40.375	40.875	7.00	6.80@6.85	5.85
3	12.50	40.375	40.875	7.00	6.80@6.85	5.70@5.75
4	12.50	40.875	41.375	7.00	6.85	5.75
Av.	12.50	40.325	40.825	7.00	6.815	5.805

*These prices correspond to the following quotations for copper delivered: May 29-June 4, 12.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
29	61½	62⅜	66¾	211	209¼	30⅜	28½	31⅛	31
30	61½	62⅜	67	208¼	206½	31¼	28⅝	31⅛	31⅛
June 2	61⅝	62½	67	212½	210¼	30⅞	28⅜	30⅞	31
3	61¾	62¾	67	209⅝	208⅞	30¾	28⅝	31	31⅛
4	61⅞	62⅞	67¼	211¾	210⅝	31	29	31¼	31¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

May	Sterling Exchange "Checks"	Silver		Gold London	June	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
29	4.31½	66½	34⅝	95s 4d	2	4.30⅜	67	35 1/16	95s10d
30	.....	...	35	95s 9d	3	4.32	67⅛	35	95s 7d
31	4.30⅛	67	35⅛	.. ..	4	4.31	66¾	34⅞	95s 6d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Average Metal Prices for May

Copper:	
New York Electrolytic	12.772
London Standard	62.006
London Electrolytic	67.648
Lead:	
New York	7.269
St. Louis	6.973
London	29.426
Silver:	
New York	65.524
London	33.870
Sterling Exchange	435.716
Zinc:	
St. Louis	5.793
London	30.648
Tin:	
99 per cent	43.611
Straits	44.111
London	218.511
Quicksilver	76.962
Antimony	8.755
Platinum:	
Refined	115.731
Crude	112.192

Metal Markets Quiet But Firm—Lead Scarce

New York, June 4—The demand for metals has not been large during the last week, but prices have been well maintained, after the advances of the week previous. This condition is largely to be attributed to strength in London.

Copper Marks Time

Sales of copper have been on an unusually small scale during the last few days, but there has been little pressure to sell, so that no weakening from the prices quoted a week ago has occurred. Practically all producers have been willing to sell at 12¾c. delivered, for June and July. For Middle Western deliveries, 12⅞c. has been secured in some instances, and for points near New York a slight shading of the 12¾c. price has occurred in one or two transactions. The individual sales have in general been of small lots, though an inquiry for 1,500 tons appeared yesterday. Export sales have not been large, but moderate tonnages have been booked for France, England, and Italy, Germany being out of the market. English bids of 12.70c., f.a.s., were received today, and it is unlikely that producers will sell copper for domestic deliveries much under the current level so long as this price obtains for foreign business.

Lead Again Strong

The official contract price of the American Smelting & Refining Co. continues at 7.00c., New York. Lead seems definitely to have struck bottom after its long decline from 9.20c.; in fact, a definite turn upward has taken place. Some holders of lead are asking as much as 7¼c., and others 7⅛c., but no sales of importance have taken place above the even figure. However, the tonnage available at 7c., for either June or July, is strictly limited. In the Middle West producers are also not anxious to sell, being perfectly willing to accumulate small stocks so that they will not again be forced to postpone deliveries at the end of a month, as they have had to do more than once this spring. Two or three are quoting 7c., St. Louis. But prompt lead has been offered today at 6.85c., and several offers at 6.85 and 6⅞c. in the last two or three days have not been taken up. Sales during the week have not been large, either in the East or Middle West, and practically all the inquiries are for small tonnages for June shipment.

Zinc Reacts Slightly

Last Thursday zinc for July shipment sold as high as 5⅞c. for a substantial tonnage, with prompt bringing 5.825c. Yesterday, however, some weak holders appeared, and the metal was sold for as low as 5.70c. Today, with a slight improvement in London, there is a little more confidence in the market. Sales have been light for the week, and mostly all to dealers, consuming demand apparently being at a standstill. New York prices continue 35c. per 100 lb. above St. Louis. High-grade has sold for 7⅞@8⅛c. delivered.

Tin at 41c. Neglected

Consumers continue to hold aloof from the tin market, and former large buyers are confining their orders to minimum carloads for prompt delivery. The situation does not look strong. Spot and forward are selling for the same price. Arrivals during May totaled 4,985 long tons, of which 2,850 was Straits; 810 English; 660 Banka and Billiton; 485 Chinese; 130 Australian; and 50 from various sources.

Foreign Exchanges Slightly Off

Most European exchanges are slightly lower than a week ago. Closing cable quotations on Tuesday, June 3, were: Francs, 5.12c.; lire, 4.3525c.; and Canadian dollars, 1 1/16 per cent discount.

Silver Mounts to New High

On June 3 the New York quotation of 67½c. touched the highest point since May 28, 1923, but on June 4 the price declined to 66¾c. on reported selling for China account. The market closes steady, with fair inquiry.

Mexican Dollars—May 29th, 50¾; 31st, 51⅛; June 2d, 51⅛; 3d, 51¼; 4th, 51.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified.

Aluminum—99 per cent, 28@29c. per lb.; 98 per cent, 27@28c.

London, 98 per cent, £125 per long ton.

Antimony—Per lb.:

Chinese and Japanese brands, 8⅜ @8½c.

W. C. C. brand, 11c.

Cookson's "C" grade, 12½c.

Chinese needle, lump, nominal, 8½ @9c.

Standard powdered needle, 200 mesh, 9@10c.

White oxide, Chinese, 99 per cent Sb_2O_3, 10@11c.

Market nominal.

Bismuth—$2.40@$2.45 per lb. London, 10s.

Cadmium—60c. per lb. London, 2s. 3d.

Cobalt—$2.50@$3 per lb. Discounts on contracts. Oxide, $2.10@$2.25. London, 10s. for metal; 9s. for black oxide.

Iridium—$260@$270 per oz. Nominal.

Iridium alloyed with platinum, $280 @$286.

Magnesium—Sticks, 1⅜ in., 99.9 per cent, 90c.@$1 per lb. London quotes 3s. 3d. for 99 per cent.

[1]Molybdenum—99 per cent, $12 per lb.

Monel Metal—32c. per lb.

Nickel—27c. per lb. for 99 per cent virgin metal. London, £135.

Osmium—$98@$108 per troy oz.

Osmiridium—Crude, $58.50 per oz.

Palladium—$78@$83 per oz. Crude, $60 per oz. London, £17.

Platinum—Refined, $116 per oz.

Crude, $112@$114.

London, £26 for manufactured.

Market firm and quiet.

Radium—$70 per mg. radium content.

Quicksilver — $75 per 75-lb. flask. San Francisco wires $72.00. London, £13¼.

Rhodium—$85@$90 per oz.

Ruthenium—$40@$45 per oz.

Selenium — Black powdered, amorphous, 99.5 per cent pure, $2.10 per lb.

Tantalum—Metal, $400 per kg.

Tellurium—$2 per lb.

[1]Thallium Metal—Ingot, 99 per cent pure, $8 per lb.

Tungsten Metal—Powder, 97 to 98 per cent, 95c.@$1 per lb. contained tungsten.

Metallic Ores

Chrome Ore—Per ton, c.i.f. Atlantic ports:

Indian, $19.50.

Rhodesian, $21.50.

New Caledonian, $24.

Market nominal.

Iron Ore—Lake Superior ores, per long ton, Lower Lake ports:

Old Range, bessemer, 55 per cent iron, $5.65.

Mesabi, bessemer, 55 per cent iron, $5.40.

Old Range, non-bessemer, 51½ per cent iron, $4.90.

Mesabi, non-bessemer, 51½ per cent iron, $4.75.

Magnetite Ore—F.o.b. Port Henry, N. Y., per long ton:

Old bed, 21 furnace, $5.

Old bed, concentrates, 63 per cent, $5.25.

Harmony, cobbed, 63 per cent, $5.25.

New bed, low-phosphorus, 65 per cent, $7.50.

Manganese Ore — 42@45c. per long ton unit, seaport, plus duty. Nominal.

Molybdenum Ore—80c. per lb. of MoS_2 for 85 per cent MoS_2 concentrates. Nominal.

Tantalum Ore—Foreign, 30@50c. per lb. of Ta_2O_5 contained, c.i.f. New York, according to quality.

Tungsten Ore—Per unit, N. Y.:

High-grade wolframite, $9@$9.25.

High-grade scheelite, $9.25.

Ordinary grades, $8.50@$8.75.

Market nominal.

Vanadium — Minimum 18 per cent V_2O_5, $1@$1.25 per lb. Nominal.

Zinc and Lead Ore Markets

Joplin, Mo., May 31—Zinc blende, per ton, high, $41.95; basis 60 per cent zinc, premium, $40; Prime Western, $39; fines and slimes, $38@$36; average settling price, all blende, $38.10.

Lead, high, $91.40; basis 80 per cent lead, $77.50; average settling price, all lead, $86.20 per ton.

Shipments for the week: Blende, 11,240; lead, 1,424 tons. Value, all ores the week, $551,140. Shipments for five months: Blende, 304,460; calamine, 372; lead, 38,599 tons. Value, all ores five months, $16,883,060.

A report has been received that a smelter at Bartlesville and one at Fort Smith will close tonight. One block at Depew was closed last week.

Zinc-ore production has been further lowered by the closing down of other mines, operators saying that there is no profit at present prices.

Platteville, Wis., May 31—Blende basis 60 per cent zinc, $41.50 to $42 per ton. Lead, basis 80 per cent lead, $85 per ton. Shipments for the week: Blende, 651 tons; lead, 40 tons. Shipments for the year: Blende, 11,207; lead, 422 tons. Shipments for the week to separating plants, 1,234 tons blende.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can only serve as a general guide as to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can only be ascertained by direct negotiation between buyer and seller.

Asbestos:

Crude No. 1—$300@$425.

Crude No. 2—$175@$250.

Spinning fibers—$90@$150.

Magnesia and compressed sheet fibers —$70@$100.

Shingle stock—$50@$70.

Paper stock—$35@$40.

Cement stock—$20@$25.

Floats—$8@$12.

All per short ton, f.o.b. mines, Quebec, tax and bags included.

Market quiet. Deliveries slow.

No. 1 Rhodesian crude, $325; No. 2, $200 per short ton, c.i.f. New York.

Barytes—Crude—$8 per ton, Missouri mines, 90@98 per cent $BaSO_4$; $9 per ton, f.o.b. Georgia mines; $6 @$8, at Baltimore.

Ground—Off color, $13 per ton, Baltimore; white, $16, Baltimore.

Water ground and floated, bleached, $23@$24, f.o.b. St. Louis.

Demand is just normal. No excess ore is being mined. General price drop in pigments has been felt by raw material.

Bauxite—American, f.o.b. shipping point per gross ton:

Crushed and dried, $5.50@$8.75.

Pulverized and dried, $12@$14.

Calcined, crushed, $20.

Foreign, per metric ton c.i.f.:

French, 5 per cent SiO_2, $5@$6.50.

Dalmatian, low SiO_2, $6.50@$7.50.

Other grades, $6.

Market quiet. Very little interest shown with exception of white (iron free) bauxite from chemical industry.

Beryl—4½c. per lb. f.o.b. Connecticut points. Nominal.

$85 per ton, hand-sorted crystals, f.o.b. New York.

Borax—Granulated and refined, crystals or powdered, in bags, carloads, 5½c. per lb.; in bbls., 5½c. Boric acid, 10½c.

Chalk—F.o.b. New York, per lb.:

English, extra light, 5c.

Domestic, light, 4½@4½c.

Domestic, heavy, 3½@3¾c.

In bulk, $5@$5.50 per ton.

China Clay (Kaolin)—F.o.b. Virginia mines, per short ton:

Crude No. 1, $7.

Crude No. 2, $6.

Washed, $8.50.

Powdered, $13@$20.

Powdered (Blue Ridge), $14@$20.

Imported English, f.o.b. American ports:

Lump, $15@$20.

Powdered, $45@$50.

1A grade, domestic, $16@$18, f.o.b. mines. Good demand.

Diatomaceous Earth—Per short ton, f.o.b. plant, California:

Kiln-fired brick, $65.

Kiln-fired aggregate, ¼ in., $45.

Insulating powder, $30.
Natural aggregate, ¼ in., $20.
Air-floated powder, $40.
Tendency to broaden use of mineral. Many industries such as glass and ceramic manufacturing are finding use of mineral increases comfort of workmen.

Emery—Per lb., f.o.b. plant:
Greek Naxos, 6½c.
Turkish, 6½c.
Khasia, 5½c.
American, 3½@4c.
Market fair to good.

Feldspar—Per long ton, f.o.b. cars, *North Carolina:*
No. 1 pottery grade, $7@$7.50, depending upon quality.
No. 2 pottery grade, $4.50@$5, depending upon quality.
No. 1 soap grade, $6.75@$7.25.
Ground, 90 to 100 mesh, $10 per short ton.

In *Connecticut*, per net ton, f.o.b. mines:
60 to 80 mesh, $20.
150 mesh, $25.
200 mesh, $30.
Some lines slow; others taking full quota. Purchasing agents confining orders to quick shipment.

In *New Hampshire*, per net ton, f.o.b. mines:
No. 1, not exceeding 10 per cent SiO_2, $8.
No. 2 pottery grade, $7.
Ground, $17@$20, f.o.b. mill.
Market better than for three months.

In *New York*, per ton, f.o.b. cars:
No. 1, $9. Demand good.

In *Maine:*
No. 1 ground, $19.
Market better than for a long time.

In *Tennessee:*
Pottery grades, $16@$21.
Tile grades, $15@$18.
Enameling grades, $11@$18.
Market fair. Production hindered by bad weather.
Crude, $7 for ordinary grades. As high as $7.50 offered for exceptional quality.

In *Canada:*
No. 1 crude, $7 per short ton.
No 1 ground, 150 mesh, $20.

Fluorspar — F.o.b. Middle Western mines, per net ton:
Not less than 80 per cent CaF_2 and not over 5 per cent SiO_2, $22.
Not less than 85 per cent CaF_2 and not over 5 per cent SiO_2, $28.50.
Ground, 93 to 98.5 per cent CaF_2 and not over 3 per cent SiO_2, $35 in bulk, $39 in bags or barrels.
Acid, ground, not less than 98½ per cent CaF_2 and not over 1 per cent SiO_2, $45 in bulk, $49 in packages.
Market poor.

Fuller's Earth—Per ton, f.o.b. Midway, Fla.:
16 to 30 mesh, $16.50.
16 to 60 mesh, $18.
30 to 60 mesh, $18.
60 to 100 mesh, $14.
Plus 100 mesh, $7.50.
Powdered, imported, duty paid, $23 @$25 per ton.

Garnet—Per short ton:
Spanish grades, $60, c.i.f. port of entry.
Domestic Adirondack, $85, f.o.b. shipping point.
Canadian, $70@$80, f.o.b. mines.

Gilsonite—Per ton, f.o.b. Colo.:
Jet asphaltum, $36.
Selects, $33.
Seconds (ordinary grades), $25.50.

Graphite—First quality, per lb.:
Ceylon lump, 5½@6c.
Ceylon chip, 4½@5c.
Ceylon dust, 3@3¾c.
Crude amorphous, $15@$35 per ton.
Powdered amorphous, 4@15c. per lb.
Flake, finely ground, 3@50c.
Lubricating quality, 7@30c.
Foundry quality, 3@8c.
Market quiet and dull.

Gypsum—Per ton, depending upon source:
Crushed rock, $3@$4.50.
Ground, $3.50@$6.
Agricultural, $5@$7.
Calcined, $8@$16.

Ilmenite—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. Virginia points. $25 per short ton, Florida mines.

Kaolin—See China Clay.

Limestone—Depending upon source, f.o.b. shipping points; per ton:
Crushed, ½ in. and less, $1.10@$1.70.
Crushed, 3 in. and larger, 90c.@$1.50.
Agricultural, $1.50@$5.

Magnesite—Per ton, f.o.b. California mines:
Calcined lump, 85 per cent MgO, $35.
Calcined ground, 200 mesh, $45.
Dead burned, $32@$34, Washington.
Dead burned, $40@$42, Chester, Pa.
Caustic calcined, Grecian, $50@$51, c.i.f., New York.
Market good.

Manjak—Barbados, in 1 to 5 ton lots:
Grade "A," 8@11c. per lb.
Grade "AA," 9½@12½c. per lb.
Grade "C," fine, 10½@13½c. per lb.
Grade "C," fine and lump, 12@15c.
Grade "C," lump, 13½@16½c.

Mica—
North Carolina prices:
Scrap, $17@$20 per ton.
Sheet, per lb., No. 1 quality, clear:
Punch, 1¼ in., 7c.

1½ x 2 in., 16c.	3 x 4 in., $1.75.
2 x 2 in., 30c.	3 x 5 in., $2.
2 x 3 in., 70c.	4 x 6 in., $3.
3 x 3 in., $1.25.	6 x 8 in., $4.50.

Ground, 60 mesh, $65 per ton.
Ground, 80 mesh, $70.
Ground, 120 mesh, $120.
Ground, 140 mesh, $125.
Other quality, 28 to 120 mesh, $29.50 @$65 per ton.
In *New Hampshire:*
Washer and disk, $280 per ton.
Scrap, $24 per ton.

[1]**Monazite**—Minimum 6 per cent ThO_2, 6@8c. per lb.

Ocher—"Yellow Peruvian," $25@$30 per ton, Georgia mines.

Ozokerite—Per lb. in bags, New York:
Black, 160 deg. melting point, 26@27c.
Green, 170 deg. melting point, 28 @29c.

Phosphate — Per long ton, f.o.b., *Florida* export prices:
76@77 per cent, pebble, $6.
75 per cent, $5.50.
74@75 per cent, $5.25.
70 per cent, $3.70.
68 per cent, $3.25.
In *Tennessee*, per long ton:
75 per cent hand mined lump, $6.75.
75 per cent washed lump, $6.75@$7.
72 per cent washed run of mine, $5.50.
65 per cent ground 95 per cent through 100 mesh, $6.50 per short ton.

Potash—Contract prices, per ton:
Kainit, 14@16 per cent, $7.33.

Pumice Stone—Imported lump, 3@40c. per lb.
Powdered, in bbl., 3@5c.
Lumps, in bbl., 6@8c.

Pyrites—Tharsis, per long ton unit, c.i.f. U. S. ports:
Furnace size, 12c.
Lump, 11½c.
Fines, through ½ in., 11½c.
Cinder from ore to remain property of buyers.
Market easier; more inquiries.

Silica—Water ground and floated, per ton, f.o.b. Illinois:
450 mesh, $31.
350 mesh, $25.
200 mesh, $20.
100 mesh, $8.
Market for amorphous silica is good.
Glass sand, $2@$2.50 per ton; brick and molding sand, $2@$2.25.

Rutile—F.o.b. Virginia points, per lb.:
Granular, 94@96 per cent TiO_2, 12@15c.
Pulverized, 100 mesh, 94@96 per cent, 17@30c.
93 per cent TiO_2, 12c., Florida, delivered.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—Per ton, in 50 lb. paper bags, *Vermont* mills, carloads:
Ground, 200 mesh, extra white, $10.50.
Ground, 180 mesh, medium white, $10.
Ground, 160 mesh, medium white, $9.50.
Demand fair. Market firm.
In *New York*, double air-floated, including containers:
200 mesh, $13.75.
325 mesh, $14.75.
100 mesh, $11, not air-floated.
Demand good.
In *California*, $20@$30 per ton, ground.
In *Georgia*, powdered, per ton:
White, $12@$15.
Grayish white, $8@$10.
Red, $12@$14.
Yellow, $8@$12.
Roofing, $7.50@$8.

Tripoli—Per short ton, burlap bags, paper liners, per minimum carload 30 tons, f.o.b. Missouri:
Once ground:
Rose and cream colored, $16@$25.
White, $18@$27.
Double ground:
Rose and cream, $17@$25.
White, $19@$30.
Air-float:
Rose and cream, $25@$30.
White, $35.
Market improving.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Zircon—Freight allowed east of Mississippi River:
99 per cent, 6c. per lb., f.o.b. Florida.
Powdered, 7c. per lb., f.o.b. Florida.

Mineral Products

Arsenious Oxide (white arsenic)—8⅜c. per lb. No demand.

Copper Sulphate—4.60@4.70c. per lb., car lots. Market surprisingly dull.

Potassium Sulphate—Basis 90 per cent, $45.85 per ton.

Sodium Nitrate—$2.35@$2.65 per 100 lb., ex vessel Atlantic ports.

Sodium Sulphate—$18@$21 per ton, New York.

Zinc Oxide—Per lb. in bags:
Lead free, 7⅞c.
5 per cent lead sulphate, 7½c.
10 to 35 per cent lead sulphate, 7c.
French, red seal, 9⅜c.
French, green seal, 10⅜c.
French, white seal, 12c.

Ferro-Alloys

[1]**Ferrocerium**—$7 per lb.

Ferrochrome—1 to 2 per cent carbon, 30c. per lb.; 4 to 6 per cent carbon, 11½c. per lb.

Ferromanganese — Domestic, 78@82 per cent, $107.50 per gross ton, f.o.b. furnace. Spiegeleisen, 19@21 per cent, $36@$38, f.o.b. furnace; 16@19 per cent, $35@$37.

Ferromolybdenum—$2 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—10 to 12 per cent, $41.50 @$46.50 per gross ton, f.o.b. works; 50 per cent, $75 delivered.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — 90@93c. per lb. of contained W, f.o.b. works. Quiet.

[1]**Ferro-uranium**—35 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works.

Ferrovanadium — $3.50@$4 per lb. of V contained, f.o.b. works. Active.

Metal Products

Rolled Copper—Sheets, 20¼c.; wire, 15¼c.

Lead Sheets—Full lead sheets, 10⅜c. per lb.; cut lead sheets, 11c. in quantity, mill lots.

Nickel Silver—26¼c. per lb. for 18 per cent nickel Grade A sheets.

Yellow Metal — Dimension sheets, 17⅜c. per lb.; rods, 14⅜c. per lb.

Zinc Sheets—9½c. per lb., f.o.b. works.

Refractories

Bauxite Brick—$140@$145 per M., Pittsburgh, Pa.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Chrome Brick—$45@$47 per net ton, f.o.b. shipping point.

Firebrick—First quality, $42@$45 per M., Ohio and Kentucky works; $42@$45 Central Pennsylvania; second quality, $35@$38.

Magnesite Brick — 9-in. straights, $65@$68 per net ton, f.o.b. works.

Magnesite Cement—$47@$50 per net ton, f.o.b. Chester, Pa.

Silica Brick—$38@$40 per M. Pennsylvania; $48@$50 Alabama.

Zirkite—Powdered, 80 per cent ZrO_2, 5c. per lb.; 70 per cent, 2½c. per lb. Brick, straights, 75@95c. each.

The Iron Trade

Pittsburgh, June 3, 1924

Steel prices show no material change. Bars, shapes and plates, which became quotable at 2.20c. to 2.30c. late in April, now quotable at the narrower range of 2.20c. to 2.25c., with the usual concession of $2 a ton or thereabouts on steel for large construction jobs.

Pig Iron—The market is dull. Prices unchanged at $22 for bessemer, $20 for basic and $20.50 for foundry, f.o.b. Valley furnaces.

Connellsville Coke.—The chief occasion of the wage reduction is the desire to make concessions to customers holding contracts for the current quarter, made long ago, at about $4.25. Spot coke is quotable at $3.25 to $3.40 for furnace, and $4.50 to $5.00 for foundry.

Imports and Exports of Metals and Ores, April, 1924 and 1923

Imports of Ores and Metals

(In Pounds, Unless Otherwise Stated)

	April, 1923	April, 1924
Antimony		
Ore	345,347	.....
Metal, matte, and regulus	522,805	2,718,539
Copper		
Ore	5,892,856	5,348,828
Concentrates	6,427,148	6,195,810
Regulus, coarse metal, and cement copper	.....	33,161
Total	12,320,004	11,577,799
Imported from		
Spain	697,440	456,887
Canada	1,609,015	2,969,892
Mexico	6,460,940	2,362,198
Cuba	.....	1,792,000
Chile	3,470,845	1,650,190
Colombia	.....	10,466
Peru	137	27,901
Other countries	81,627	2,308,265
Unrefined black, blister, and converter copper in pigs, and other forms	14,264,976	31,688,505
Imported from:		
Canada	4,605,538	5,528,287
Mexico	3,920,283	7,082,030
Chile	2,254,160	7,013,143
Peru	.....	4,428,445
Portuguese Africa	3,484,995	9,630,942
Other countries	.....	5,658
Refined copper	8,726,570	10,068,760
Old and clippings for remanufacture	1,010,956	221,806
Composition metal, copper chief value	810,421	20,752
Copper manufactures	17,083	7,122
Brass		
Old and clippings for remanufacture	7,786,836	1,012,369
Manufactures of brass	49,205	58,123
Lead		
Ore and matte	8,900,027	3,722,825
Bullion or base bullion	8,253,032	17,910,771
Pigs, bars, other forms and old	15,463,063	5,195,063
Manufactures of, except type metal	72,896	27,637
Manganese ore, long tons	14,071	29,729
Pyrites, long tons	22,020	13,721
Tin		
Tin ore, tons	779	21
Tin in bars, blocks, and pigs	16,914,130	22,806,793
Imported from:		
United Kingdom	1,516,132	2,236,681
British Straits Settlements	10,916,966	18,185,967
China	.....	56,113
Dutch East Indies	2,199,610	675,595
Hongkong	1,580,004	1,001,617
Australia	185,920	89,690
Other countries	515,498	561,130
Zinc ore	273,437	.....
Zinc in blocks, pigs, and other forms (dutiable)	4,259	8,202
Zinc dust (dutiable)	.....	4,074

Exports of Copper, Lead and Zinc

(In Pounds)

	April, 1923	April, 1924
Copper		
Ores, concentrates, matte, regulus (copper content)	74,680	600
Copper and manufactures of	65,710,350	99,792,036
Refined, in ingots, bars, and other forms	55,891,315	91,265,411
Exported to		
Belgium	4,070,119	9,243,118
France	16,067,575	17,220,055
Germany	10,012,738	24,606,051
Italy	3,778,407	10,453,984
Netherlands	572,687	6,336,714
Spain	828,691	632,470
Sweden	1,774,904	3,530,920
United Kingdom	12,043,890	11,268,240
Canada	2,634,122	1,452,749
China	2,282,800	1,388,800
Japan	1,522,954	3,416,105
Other countries	302,428	1,716,205
Old and scrap	232,515	707,335
Composition metal, copper chief value	4,640	31,943
Pipes and tubes	159,338	140,355
Plates and sheets	240,304	623,381
Lead		
Pigs, bars and other forms		
From domestic ore	96,318	1,115,557
From foreign ore	2,352,922	6,330,026
Exported to:		
France	224,039	2,016,132
Germany	.....	840,253
Netherlands	224,059	224,025
United Kingdom	1,568,084	2,969,334
Other Europe	.....	560,875
Argentina	.....	112,000
Brazil	224,084	448,060
Other countries	208,974	274,904
Zinc		
Ore, concentrates and dross	1,779,872	1,252,951
Spelter; cast in slabs, blocks and other forms	3,485,307	7,195,380
Exported to:		
Belgium	336,047	112,022
France	560,011	1,460,982
Germany	.....	1,064,129
United Kingdom	2,563,443	3,935,712
Canada	2,098	38,501
Other countries	23,708	584,034
In sheets, strips, and other forms	594,010	697,733
Zinc dust	232,545	498,209
Other zinc manufactures	122,711	125,047

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1923	1924	1923	1924	1923	1924
January	65.668	63.447	31.928	33.549	465.053	425.524
February	64.313	64.359	30.875	33.565	468.631	430.457
March	67.556	63.957	32.310	33.483	469.269	428.769
April	66.855	64.139	32.346	33.065	465.220	434.788
May	67.043	65.524	32.611	33.870	462.252	435.716
June	64.861	.....	31.611	.....	461.132	.....
July	63.015	.....	30.942	.....	458.025	.....
August	62.793	.....	30.952	.....	455.714	.....
September	64.203	.....	31.698	.....	453.901	.....
October	63.649	.....	31.718	.....	452.024	.....
November	63.818	.....	32.774	.....	437.839	.....
December	64.705	.....	33.375	.....	435.500	.....
Year	64.873	.....	31.929	.....	457.047	.....

New York quotations, cents per ounce troy, 999 fine, foreign silver. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1923	1924	1923	1924	1923	1924
January	14.510	12.401	64.494	61.273	71.409	67.193
February	15.355	12.708	67.700	63.113	74.500	68.167
March	16.832	13.515	73.851	66.137	81.464	72.087
April	16.663	13.206	73.169	64.338	81.331	70.150
May	15.440	12.772	67.460	62.006	76.568	67.648
June	14.663	.....	66.607	.....	73.238	.....
July	14.321	.....	65.278	.....	72.364	.....
August	13.822	.....	64.034	.....	70.000	.....
September	13.323	.....	63.194	.....	68.275	.....
October	12.574	.....	60.614	.....	64.250	.....
November	12.727	.....	61.648	.....	66.477	.....
December	12.823	.....	62.035	.....	67.611	.....
Year	14.421	.....	65.840	.....	72.291	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1923	1924	1923	1924	1923	1924
January	7.633	7.972	7.571	8.002	27.119	31.528
February	8.050	8.554	8.093	8.643	28.519	34.589
March	8.252	9.013	8.254	8.891	28.815	37.161
April	8.101	8.263	7.996	7.932	26.956	32.819
May	7.306	7.269	7.085	6.973	25.614	29.426
June	7.146	.....	6.852	.....	25.429	.....
July	6.237	.....	6.126	.....	24.188	.....
August	6.582	.....	6.496	.....	24.222	.....
September	6.856	.....	6.700	.....	25.688	.....
October	6.831	.....	6.570	.....	27.815	.....
November	6.846	.....	6.582	.....	30.352	.....
December	7.369	.....	7.369	.....	31.042	.....
	7.267	.....	7.141	.....	27.147	.....

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1923	1924	1923	1924	1923	1924
January	37.986	48.250	39.173	48.750	181.852	246.790
February	40.693	52.772	42.011	53.272	190.513	272.399
March	46.569	54.370	48.569	54.870	219.607	277.429
April	44.280	49.457	45.810	49.957	213.081	250.863
May	42.346	43.611	43.135	44.111	203.097	218.511
June	40.375	.....	40.957	.....	191.798	.....
July	37.970	.....	38.490	.....	181.188	.....
August	38.841	.....	39.269	.....	186.705	.....
September	41.047	.....	41.547	.....	198.263	.....
October	41.322	.....	41.851	.....	203.957	.....
November	43.495	.....	43.995	.....	220.710	.....
December	46.662	.....	47.160	.....	235.007	.....
Year	41.799	.....	42.664	.....	202.148	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1923	1924	1923	1924
January	6.815	6.426	35.733	34.761
February	7.152	6.756	35.613	36.518
March	7.706	6.488	36.720	35.238
April	7.197	6.121	34.275	32.588
May	6.625	5.793	31.057	30.643
June	6.031	.....	29.548	.....
July	6.089	.....	29.335	.....
August	6.325	.....	32.386	.....
September	6.438	.....	33.469	.....
October	6.293	.....	32.995	.....
November	6.347	.....	32.949	.....
December	6.260	.....	32.611	.....
Year	6.607	.....	33.058	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)		
	New York		New York		Refined New York		Crude New York
	1923	1924	1923	1924	1923	1924	1924
January	6.884	10.279	72.731	59.500	112.462	122.115	115.500
February	7.290	10.935	70.636	59.565	113.273	124.739	115.935
March	8.885	11.442	70.808	64.269	110.846	121.692	113.231
April	8.380	9.952	69.200	74.308	116.840	115.577	108.077
May	7.477	8.755	68.000	76.962	115.007	115.731	112.192
June	6.839	.....	67.769	.....	115.615	.....	.....
July	7.097	.....	66.980	.....	116.000	.....	.....
August	7.753	.....	65.212	.....	116.000	.....	.....
September	7.633	.....	63.000	.....	116.000	.....	.....
October	8.005	.....	61.769	.....	116.923	.....	.....
November	9.156	.....	61.917	.....	124.479	.....	.....
December	9.365	.....	60.000	.....	125.000	.....	.....
Year	7.897	.....	66.502	.....	116.537	.....	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1923	1924	1923	1924	1923	1924
January	29.27	24.76	27.35	23.76	28.77	23.88
February	29.79	25.26	28.15	23.76	27.21	25.06
March	32.03	25.14	31.79	23.76	31.77	24.70
April	32.77	24.56	32.77	23.26	32.77	23.80
May	31.87	23.89	29.83	22.08	32.46	22.91
June	30.27	.....	28.34	.....	29.81	.....
July	28.47	.....	26.52	.....	27.47	.....
August	28.27	.....	26.77	.....	26.77	.....
September	28.26	.....	26.26	.....	26.72	.....
October	26.96	.....	25.01	.....	25.52	.....
November	24.79	.....	22.57	.....	23.60	.....
December	24.54	.....	22.62	.....	23..2	.....
Year	28.94	.....	27.33	.....	28.05	.....

In dollars per long ton.

Monthly Crude Copper Production

Domestic

	1924			
	January	February	March	April
Alaska shipments	5,753,719	8,248,221	9,388,162	6,538,827
Calumet & Arizona	3,764,000	2,824,000	2,084,000	3,330,000
Miami	5,884,000	4,965,000	5,311,000	5,163,000
New Cornelia	3,221,044	4,452,402	5,875,334	5,472,542
Old Dominion	2,344,000	2,250,000	2,100,000	2,071,000
Phelps Dodge	9,818,000	10,112,000	10,597,000	10,673,000
United Verde Extension	3,517,862	3,901,444	3,302,766	3,809,584
A.S. & R. & Tenn. Copper	12,500,000	16,200,000	14,000,000	17,000,000
Imports: Ore and concentrates, matte	10,168,066	17,317,820	9,479,348	11,577,799
Partly from				
Chile	6,755,405	4,795,426	5,685,837	1,650,196
Cuba	.....	1,776,580	.....	1,792,000
Canada	94,167	5,824,253	665,007	2,969,892
Mexico	1,271,400	2,084,880	2,316,464	2,362,198
Imports of black and blister, unrefined	41,962,680	37,994,544	47,332,796	31,688,505
Partly from				
Chile	1,664,624	9,552,381	13,396,214	7,013,143
Peru	7,538,508	5,073,385	12,413,463	2,428,445
Africa	20,525,910	6,090,290	9,231,241	9,630,942
Mexico	7,229,476	5,008,783	5,808,720	7,082,030
Imports of refined and old	16,941,465	13,133,379	8,,18,668	10,318,440

Foreign

Boleo, Mexico	1,486,721	1,356,075	1,454,198	976,815
Falcon Mines, Rhodesia	492,000	494,800	504,952	.....
urukawa, Japan	2,162,972	2,939,214	3,416,954	.....
Granby Cons., Canada	3,268,463	2,934,214	3,977,000	3,229,788
Katanga, Africa	11,299,900	11,243,295	13,496,805	13,902,525
Mount Morgan, Aust	493,000	702,000	440,000	.....
Mount Lyell, Aust	774.000	884,000	1,322,000	.....
Phelps Dodge Mexican	3,395,000	2,983,000	3,047,000	3,175,000
Sumitomo, Japan	2,713,584	2,806,044	2,485,976	.....
Wallaroo & Moonta, Aust	(a)	(a)	(a)	(a)

Comparative U. S. Monthly Copper Production

	1921	1922	1923	1924
January	90,596,597	32,010,292	112,267,000	133,356,000
February	86,682,941	45,957,530	102,725,000	128,260,000
March	91,046,345	55,705,760	121,562,000	129,816,000
April	46,946,523	76,601,000	118,157,000	131,600,000
May	25,310,511	88,714,000	125,438,000	.....
June	24,623,693	93,740,000	125,479,000	.....
July	22,033,739	91,000,000	125,249,000	.....
August	23,248,398	101,188,000	131,088,000	.....
September	23,855,316	96,408,000	124,523,000	.....
October	23,231,572	103,273,000	132,481,000	.....
November	28,341,442	102,845,000	127,963,000	.....
December	26,629,137	103,003,000	129,354,000	.....

(a) Not available.

Company Reports

Erupcion Mining Co.

Silver-lead; Los Lamentos, Chih., Mexico.

The Erupcion Mining Co. operated continuously during 1923, according to a report of the company for that period. From the 74,849 wet tons of ore produced during the year, the smelting company accounted and paid for 388,833 oz. of silver and delivered to the Erupcion company 33,873,985 lb. of lead.

During the year three dividends aggregating 37½c. per share of issued stock of the company were declared, totaling $468,750.

The company expended in joint account with the Ahumada Lead Co., $96,675.70 for construction, of which Erupcion is responsible for approximately one-half, and in addition to this has purchased a number of 50-ton steel cars for ore transportation at a cost of $33,205.62, which cars have been leased to the Cia. del Ferrocarril de Chihuahua y Oriente, S. A.

Consolidated Balance Sheet

Assets

Cash on hand and in banks	$73,685.95	
Accounts receivable	297,348.21	
		$371,034.16
Metal inventory	$274,332.43	
Materials and supplies	33,405.07	
Prepaid expense	5,821.02	
		313,558.52
Mining claims, and equipment	$634,439.92	
Chihuahua & Oriente R.R. stock	296,250.00	
		930,689.92
Discount on stock		431,000.00
		$2,046,282.60

Liabilities

Accounts payable	$228,507.84
Reserves, surplus and legal reserve	567,774.76
Capital stock	1,250,000.00
	$2,046,282.60

Montana-Bingham Consolidated Mining Co.

A report of the operations of the Montana-Bingham Consolidated Mining Co. for 1923 states that the company sustained a deficit for the year of $54,220.70, after deducting all prospecting and development, bond interest, depletion, and other charges, compared with $63,437.22 in 1922. On Oct. 10 an assessment, No. 8, of 2c. per share, was levied.

Balance sheet as of Dec. 31, 1923 follows:

Assets

Mine properties, mill, etc.		$3,323,614.04
Tiewaukee mining properties		17,074.01
Investment in capital stock of the United Bingham Copper Co. (par value $16,500)		54,300.00
Current assets		$41,507.62
Deferred charges	2,436.02	
Total		$3,438,931.69

Liabilities

Capital stock—authorized 3,000,000 shares		
Issued 2,572,502 shares of $1 each	$2,572,502.00	
Less 29,907 shares in treasury	29,907.00	
		$2,542,595.00
First mortgage 7 per cent bonds, due 1933	197,600.00	
Current liabilities		3,488.47
Surplus		
Appreciation of property	$661,675.00	
Assessments paid	35,932.96	
Assessment No. 8, Oct. 10, 1923, of 2c. per share, and stock acquired at assessment sale Dec. 20, 1923, less expenses	51,860.96	
Total	$749,468.92	
Less deficit for the year	54,220.70	695,248.22
Total		$3,438,931.69

Production is given as follows:

	Gold Ounces	Silver Ounces	Copper Pounds	Lead Pounds
Copper ore	633.684	14,892	566,148	.....
Lead ore	1.186	245	754	15,817
Iron ore	4.618	46	1,385	.....
Totals	639.488	15,183	568,287	15,817

Betty O'Neal Mines

Silver; Battle Mountain, Nev.

A report of the operations of the Betty O'Neal Mines for 1923 states that net income after taxes amounted to $156,593.28, as follows:

Mining and milling 38,150 tons of ore, average net yield	$438,057.75
Cost of operation, including development, repairs, renewals, and administration	270,325.70
Leaving earnings of	$167,732.05
Other income	510.42
Total income	$168,242.47
Taxes	11,649.19
Surplus after taxes	$156,593.28

Balance Sheet, Dec. 31, 1923

Assets

Cash balance		$33,055 74
Notes receivable		1,450.00
Receivable for concentrates		25,333.16
Sundries receivable		4,391 54
Investment—stock		275 00
Prepaid charges—insurance		1,250.00
Betty O'Neal property	$1,066,495.47	
Cash mine property	591,359.67	
Buildings	29,744.30	
Mill buildings and equipment	208,764.49	
General equipment	61,316.42	
General development	206,827.98	
Auto and truck equipment	2,359.10	
Office equipment (mine and Boston)	1,521.31	
Total property	$2,168,388.74	
Less depreciation and depletion	109,255.66	
		2,059,133.08
Total		$2,124,888.52

Liabilities

Accounts payable:	
Royalty (Minerals Separation Corporation)	$9,123.42
Sundry accounts payable	16,153.38
Capital stock outstanding	1,972,000.00
Surplus	127,611.72
Total	$2,124,888.52

Production amounted to 38,150 tons milled, yielding 652,606 oz. of silver from the smelter. The first unit of the Betty O'Neal mill was completed and put in operation on Oct. 23, 1922. In February, 1923, the shareholders received the first dividend of 15c. per share. A second dividend, also of 15c. per share, was paid in May, 1923. In all, the Betty O'Neal Mines paid to shareholders in dividends $117,056.10 in 1923.

Shattuck Arizona Copper Co.

Shattuck Arizona for the first quarter of 1924 shows a net income of $76,001.86 before depreciation and depletion. The shipments of copper ore to the smelter were at the rate of 75 tons per working day. Shipments of lead ore were at the rate of 150 tons per day until March 1, when the company was forced to reduce them to 100 tons per day to meet the requirements of the smelter.

The production and costs per pound for the first quarter are as follows:

	Copper	Lead and Silica
Dry tons mined	5,473.47	11,554.27
Dry tons treated	5,529.26	12,350.14
Pounds copper recovered	814,702	31,005
Pounds lead recovered	.....	1,373,442
Ounces silver recovered	28,112	82,780
Ounces gold recovered	262.68	1,034.08
Net operating cost per pound, cents	7.95	6.33

The net operating cost is for delivered metal after credit for gold and silver byproducts, but before depreciation, depletion, and deferred development expense. The results in earnings for the quarter were as follows:

Refined copper at 13½ c. per lb.		$109,984.77
Gold and silver byproducts		24,473.63
Lead and silica smelter settlements		184,253.60
Interest		9,056.66
Dividends		170.00
Total		$327,938.66
Operating expense, copper	$88,738.19	
Operating expense, lead and silica	158,538.52	
Administrative expense	4,660.09	251,936 80
Net income, plus depreciation, depletion and deferred development		$76,001.86

The earnings on copper produced for the quarter are obtained by inventorying copper at 13½c. per pound, silver at 60c. and gold at $20.

Mining Stocks

Week Ended May 31, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb			*10		
Anaconda	New York	30⅛	29¼	29⅝	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	1	1	1		
Ariz. Com'l.	Boston	8½	8	8¼	Ja.15, Ja.31	0.50
Calaveras	N. Y. Curb			1⅛		
Calumet & Arizona	Boston	44⅜	44¼	44¼	Jn 6, Ju. 23 Q	0.50
Cal. & Hecla (New)	Boston	15⅜	14⅛	14⅛	My. 31, Jn. 16	0.50
Canario Copper	N. Y. Curb	2¼	2 3/16	2⅛		
Cerro de Pasco	New York	45¼	44⅛	44¼	Ap. 17, My. 1	1.00
Chile Copper	New York	42⅜	41⅛	42	Jn.2, Jn.30, Q	0.62½
Chino	New York	27⅞	27⅛	27⅜	Sept., 1920,	0.37½
Con. Coppermines	N. Y. Curb	2⅛	2	2		
Copper Range	Boston	20	19¾	19¾	May, 1923	1.00
Crystal Copper	Boston Curb	56	54	54		
Davis-Daly	Boston	*48	*48	*48	Mar., 1920	0.25
East Butte	Boston	4	4	4	Dec., 1919	0.50
First National	Boston Curb			*27	Feb., 1919	0.15
Franklin	Boston	†*60				
Gadsden Copper	Boston Curb	43	43	43		
Granby Consol.	New York			13½	May, 1919	1.25
Greene-Cananea	New York			10	Nov., 1920	0.50
Hancock	Boston			1		
Howe Sound	N. Y. Curb	2⅜	2⅛	2⅛	Ap.1, Ap.15, Q	0.05
Inspiration Consol.	New York	23⅛	22⅞	22⅞	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb			2⅛	May, 1923	0.15
Isle Royale	Boston	13	13	13	Se. 1, Se. 15,	0.50
Jerome Verde Dev.	N. Y. Curb	1	*98	*98		
Jib Consol.	N. Y. Curb	*29	*22	*22		
Kennecott	New York	38⅛	38⅛	38⅛	Jn.6, Jy. 1, Q	0.75
Keweenaw	Boston			*75		
Lake Copper	Boston	†1½				
Magma Copper	New York	29½	27⅞	28½	Jan., 1919	0.50
Mason Valley	N. Y. Curb			1⅜		
Mass Consolidated	Boston	*60	*60	*60	Nov., 1917	1.00
Miami Copper	New York	20⅛	20¼	20¼	My. 1, My. 15, Q	0.50
Mohawk	Boston	†26⅛			Se. 22, Oc. 13,	1.00
Mother Lode Coa.	New York	7⅜	6⅞	7⅛	Jn.13, Jn.30	0.37½
Nevada Consol.	New York	13⅛	13	13	Sept., 1920,	0.25
New Cornelia	Boston	18⅛	17⅞	18⅛	My.9, My.26,	0.25
New Dominion	N. Y. Curb			2⅜		
North Butte	Boston	3⅛	2⅞	3⅛	Oct., 1918,	0.25
Ohio Copper	N. Y. Curb	*92	*88	*90		
Old Dominion	Boston	18⅛	17⅞	17⅞	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†110			Mc.24, Ap.2 Q	1.00
Quincy	Boston	15	14⅞	14⅞	Mar., 1920	1.00
Ray Consolidated	New York	10⅜	9⅞	10⅛	Dec., 1920	0.25
Ray Hercules	N. Y. Curb	*13	*13	*13		
St. Mary's Min. Ld.	Boston	28	27⅛	27⅛	Ap.22, My.20	3.00
Seneca Copper	New York	⅛	⅛	⅛		
Shannon	Boston	†*31	...	...	Nov., 1917	0.25
Shattuck Arizona	New York			4½	Jan., 1920	0.25
Superior & Boston	Boston	*60	*60	*60		
Tenn. C. & C. ofs.	New York	7	7	7	De.31, Ja.15, Q	0.25
Utah Copper	New York	67½	67⅛	67⅛	Mc.14, Mc.31, Q	1.00
Utah Metal & T.	Boston	*30	*30	*30	Dec., 1917	0.30
Victoria	Boston	†60	...	...		
Walker Mining	N. Y. Curb	3	2⅞	2 15/16		
Winona	Boston	†*19	...	...		
NICKEL-COPPER						
Internat. Nickel	New York	12	11⅝	11⅞	Mar., 1919	0.50
Internat. Nickel pfd.	New York	76	75½	75½	Ap.17, My.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	*¾	*¾			
National Lead	New York	133	130¼	130¾	Ja.13, Jn.30, Q	2.00
National Lead pfd.	New York	111½	111½	111½	My. 23, Ju. 14, Q	1.75
St. Joseph Lead	New York	24	23⅝	24	Se. 9, Se.20	0.50
ZINC						
Am. Z. L. & S.	New York	7	7	7	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	25	25	25	Nov., 1920	1.50
Butte C. & Z.	New York	4½	4½	4½	Ma., 1923	0.50
Butte & Superior	New York	14½	14	14⅜	Je.15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	3⅜	3½	3½	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	137⅜	137⅛	137⅞	May 10, 1924	2.00
United Zinc	N. Y. Curb			*25		
Yellow Pine	Los Angeles	70	68½	70	Mar., 1924	0.04
SILVER						
Alvarado	N. Y. Curb	...	...	1		
Beaver Consol.	Toronto	17½	16	16	May, 1920	0.03
Castle-Trethewey	Toronto	†*65½	†*58	*66		
Coniagas	Toronto	1.90	1.85	1.85	Ap.20, My.1	0.02½
Crown Reserve	Toronto	*57	*51	*58	Jan., 1917	0.05
Keeley	Toronto	†2.17	†2.14	2.19		
Kerr Lake	N. Y. Curb	1⅜	1⅜	1⅜	Ap.1, Ap.15, Q	0.12
La Rose	Toronto	*12	*10½	*10½	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.35	1.30	1.33		
McKinley-Dar.-Sav.	Toronto	†*12	†*11½	*13	Oct., 1920	0.03
Mining Corp. Can.	Toronto	†3.05	†2.95	2.92	Sept. 1919	0.12½
Nipissing	N. Y. Curb	6	5⅞	6	Mc.k Ap.21, Q	0.03½
Ontario Silver	New York	5⅜	5⅜	5⅜	Jan., 1919	0.50
Temiskaming	Toronto	*21	*20½	*21	Jan., 1920	0.40
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Argonaut	Toronto	†*47½	†*43½	*48		

Stock	Exch.	High	Low	Last		Last Div.
Carson Hill	Boston	1⅛	1⅛	1⅛		
Cresson Consol. G	N. Y. Curb	3⅜	3⅜	3⅜	Mc.3, Ap.10, Q	0.10
Dome Mines	New York	16⅛	15⅝	16	Mc.26, Ap 21, Q	0.50
Golden Cycle	Colo. Springs			1.32	My.31, Jn.10 Q	0.03
Hollinger Consol.	Toronto	12.80	12.70	12.69	My.29, Jn.16, M	0.05
Homestake Mining	New York	48¾	48⅛	48⅛	My.10, My.26,	.50
Kirkland Lake	Toronto	20	19⅛	19⅛		
Lake Shore	Toronto	3.73	3.69	3.69	My.2, My.15	0.02
McIntyre-Porcupine	New York	15⅛	15	15	Ap. 1, My. 1,	0.25
Newray	Toronto	*31	*28	*31		
Portland	Colo. Springs	58	57	57	Oct., 1920	0.01
Teck-Hughes	Toronto	†1.11	...	...		
Tom Reed	Los Angeles	35	33	33	Dec., '1919	0.02
Tough-Oakes	Toronto	†*64	†*63	62½		
United Eastern	N. Y. Curb	*64	*62	*62	Ap 10, Ap.28, Q	0.10
Vipond Cons.	Toronto	†1.02	†1.01	1.03		
Wright-Hargreaves	Toronto	3.00	2.90	2.95	Mc.15, Ap. 1, Q	0.02½
GOLD AND SILVER						
Black Oak	N. Y. Curb	*73	*73	*73		
Con. Cortez	N. Y. Curb	*43	*36	*43		
Con. Virginia	San Francisco	4½	4½	4½		
Continental Mines	N. Y. Curb	...	...	2½		
Dolores Esperanza	N. Y. Curb	...	...	*50	Jy. 1, Jy. 10 Q	0.05
Premier Gold	N. Y. Curb	2	2	2	Mc.28, Ap.5	0.08
Tonopah Belmont	N. Y. Curb	*63	*60	*62	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb	*22	*21	*21	Se.22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	2⅛	2 3/16	2⅛	Jn. 10, Jy. 1	0.05
Tonopah Mining	N. Y. Curb	1 3/16	1 3/16	1 3/16	Ap. 6, Ap. 21	0.07½
Unity Gold	N. Y. Curb	1	1	1		
West End Consol.	N. Y. Curb	*51	*50	*50	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	*55	*50	*50	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	5⅜	5⅛	5⅛	Mc., Ap. 2, X	0.15
Bingham Mines	Boston	†14½			Sept., 1919	0.25
Cardiff M. & M.	Salt Lake	*93	*85	*93	Dec., 1920	0.15
Chief Consol.	Boston Curb	3⅛	3 3/16	3⅛	Ap 19, My. 1, Q	0.10
Columbus Rexall	Salt Lake	24	22½	22½	Aug., 1922	0.03
Consol. M. & S.	Montrea !	39½	38	38½	Oct., 1920	0.62½
Daly Mining	Salt Lake	....	....	205	July, 1920	0.10
Erupcion	Boston Curb	2¼	2¼	2¼	Mc. 15, Ap.2, X	0.15
Federal M. & S.	New York	...	...	8½	Jan., 1909	1.50
Federal M. & S. pfd.	New York	...	...	44	My.26, Jn.15, Q.	1.75
Florence Silver	Spokane	14	12	12	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb	8⅞	8⅛	8⅛	My.15, Jn.15,	0.25
Iron Blossom Con.	N. Y. Curb	....	....	*26	Oct., 1923	0.02
Marsh Mines	N. Y. Curb	....	....	*7	June, 1921	0.02½
Park City	Salt Lake	....	....	4.00	Mar., 1924	0.15
Park Utah	N. Y. Curb	....	....	3½	Mc.15, Ap.1	0.15
Prince Consol.	Salt Lake	*6	*4½	*5¼	Nov., 1917	0.02
Silver King	N. Y. Curb	...	...	*60	Ap. 1, X	0.30
Silversmith	Spokane	40	40	40	My. 1, My. 10	0.01
Tamarack-Custer	Spokane	1.65	1.60	1.60	Se.30, Oc. 1, K	0.02
Tintic Standard	Salt Lake	4.25	4.20	4.25	Mar. 25, 24, QX	0.15
Utah-Apex	Boston	2⅛	2⅛	2⅛	June, 1923,	0.50
IRON						
Bethlehem Steel	New York	49¼	47¼	48	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit	1	1	1		
Char. Iron pfd.	Detroit			1		
Colorado Fuel & Iron	New York	40¼	38⅛	39½	My.10, My.26 Q	2.00
Col. Fuel & Iron pfd.	New York			102	Feb., 1923	2.00
Gt. North'n Iron Ore	New York	26⅛	26⅛	26⅛	De.10, De.27	2.00
Inland Steel	N. Y. Curb	....	....	46	My.15, Jn. 1 Q	0.62½
Mesabi Iron	N. Y. Curb	....	....	2½		
Replogle Steel	New York	8	8	8		
Republic I. & S.	New York	45	43½	43⅝	May, 1921	1.50
Republic I. & S. pfd.	New York	....	....	88	Jn.14, Jy.1, Q	1.75
Sloss-Sheffield S.&I.	New York	55	54½	54½	Jn.6, Jn.20, Q	1.50
Sloss-Shef. S.&I.pfd.	New York	....	....	82	Jn.18, Jy.2, Q	1.75
U. S. Steel	New York	98½	94⅞	95½	Jn.1, Jn.28 QX	1.75
U. S. Steel pfd.	New York	119⅞	119	119⅜	My.6, My.29, Q	1.75
Virginia I. C. & C.	New York	38	37	37	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York	....	....	74	Jn.17, Jy.1	2.50
VANADIUM						
Vanadium Corp.	New York	22¾	21⅛	21⅜	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	24	24	24		
ASBESTOS						
Asbestos Corp.	Montreal	25½	25½	25½	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal	52¼	52¼	52¼	Ap.1, Ap.15, Q	1.50
SULPHUR						
Freeport Texas	New York	9⅛	8⅜	8⅜	Nov., 1919,	1.00
Texas Gulf	New York	61¼	59¼	59½	My.31, Jn.14 QX	1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	...	...	3⅜		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	40	39⅛	39⅛	My.20, Jn.1, Q	0.75
Amer. Metal pfd.	New York	...	...	109⅛	My.20, Jn.1, Q	1.75
Amer. Sm. & Ref.	New York	62⅜	61	61⅛	Ap. 11, My. 1, Q	1.25
Amer. Sm. & Ref. pfd.	New York	...	...	100	My. 9, Jn. 1,	1.75
U. S. Sm. R. & M.	New York	20⅛	20	20	Jan., 1921,	0.50
U. S. Sm. R. & M. pfd.	New York	38⅛	38⅛	38⅛	Apr., 1924, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.